, APRIL 29, 1937

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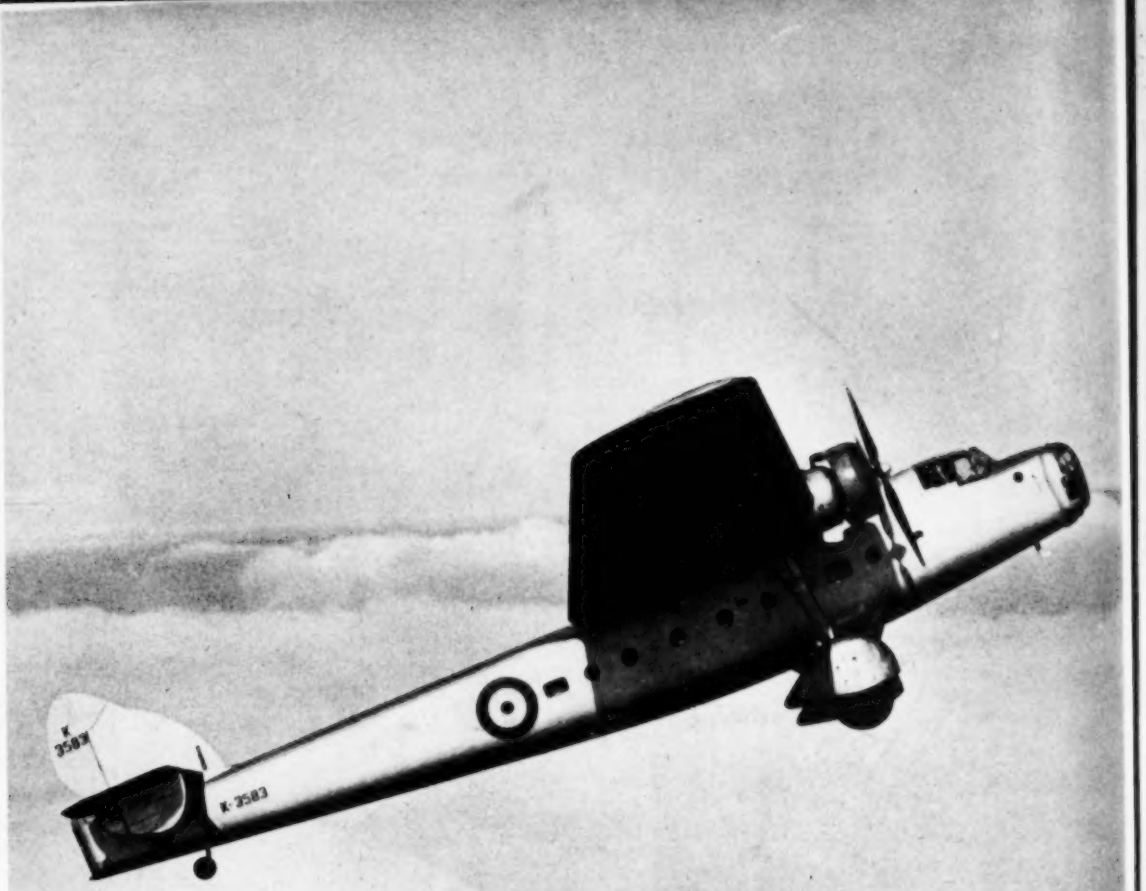

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FLIGHT

The AIRCRAFT ENGINEER AND AIRSHIPS

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Ninepins

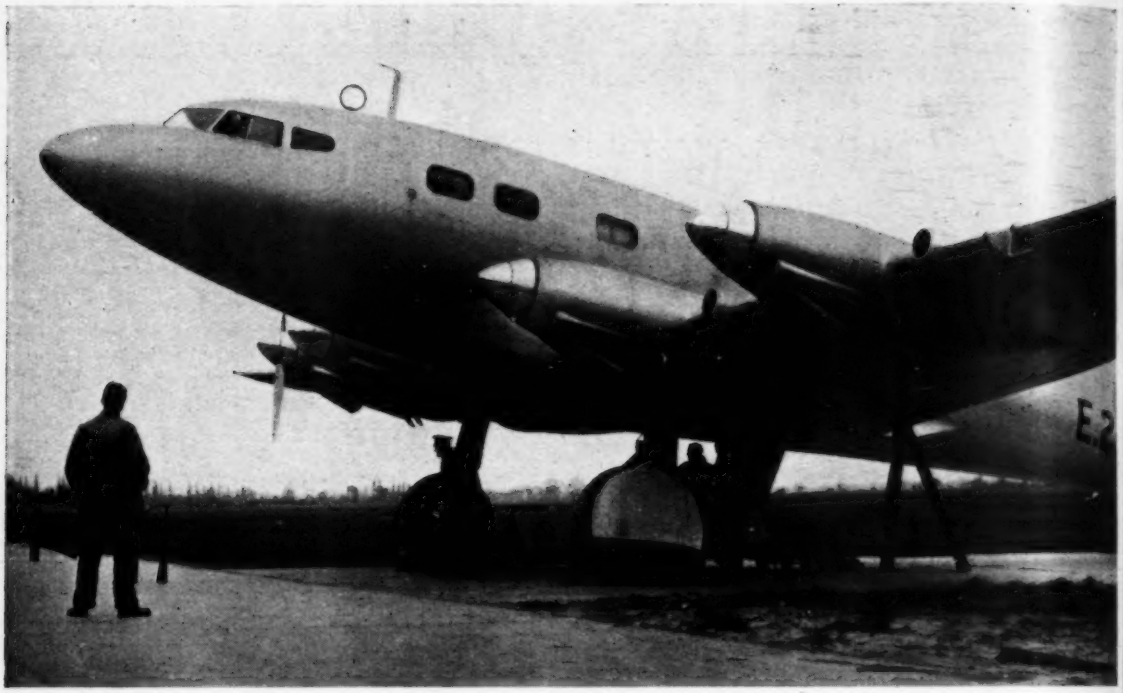
ONE of the most refreshing breaks in a task in the details of which one has been submerged for a number of months or even years is afforded by sitting back and asking oneself: "What is it I am trying to do? What are the ideals at which I am aiming, and how far have I progressed towards reaching them?" Last Monday Mr. H. E. Wimperis, until recently Director of Scientific Research at the Air Ministry, gave the aviation community such a pause for reflection. He chose for his Presidential Address to the Royal Aeronautical Society the subject of natural limits to human flight. In spite of admitting a feeling of rashness, Mr. Wimperis managed to keep his audience fascinated by stating his views of what *can* be done in flying, and by suggesting what cannot be done. He excused his temerity by describing the limits set by him as a row of aeronautical ninepins, which might encourage the resourcefulness of coming generations by providing them with the zest of knocking these ninepins down.

One frequently reads that this or that authority on flying matters foresees the time when aircraft will travel from Europe to America at fantastic speeds. The President of the Royal Aeronautical Society set up one ninepin by declaring quite definitely that 600 m.p.h. will be the limit. He based his argument on the fact that the speed of sound is 750 m.p.h. at ground level and only 650 m.p.h. in the stratosphere. Air can only move at the speed of sound, and the result of pushing an aeroplane through the air at greater speed was very aptly compared by Mr. Wimperis with trying to drive an unlighted motor car through a crowd of deaf people on a dark night. The difference between the speed of sound and the maximum of 600 m.p.h. is accounted for by the fact that the air speed over the top of the wing is appreciably greater than the air speed of the aeroplane itself. Unless a power plant very different from the internal combustion engine as we know it comes along, there is thus little chance of knocking over this particular ninepin.

Not quite so steady on its feet seems to be Mr. Wimperis' power-dive ninepin. He quoted Wing-Commander Marshall's paper to the Royal Aeronautical Society as authority for dives of 30,000ft. per minute without harmful biophysical effect, and compared a dive through 8,000ft. at 400 m.p.h. with the change of pressure encountered by a swimmer diving 10ft. into water, the rate of change of pressure being also about the same. One hesitates to presume to anticipate Mr. Wimperis' "resourceful coming generations," but from personal experience we find it a little difficult to subscribe to the general statement, true though it may be when applied to R.A.F. pilots with long training.

Altitude Flying

It is rather to be regretted that Mr. Wimperis did not include in his very interesting lecture a more detailed reference to pressure cabins. He did say that the rate of climb of an aircraft is not such as to produce a rate of pressure change which can have important effects on the occupants of an open cockpit, but a pressure cabin punctured accidentally might give a very good imitation of a rate of climb comparable in magnitude with the rate of descent in a power dive. American experiments, as mentioned in *Flight* recently, have shown that when the pressure difference is limited to about 5 lb. per sq. in. no ill-effects are felt, but for real stratosphere flying it seems probable that the cabin would have to be kept at a pressure corresponding to about 12,000ft., and in that case the difference in pressure between the inside and outside of the cabin would probably be considerably greater. Mr. Wimperis admitted the practicability of the sealed cabin, theoretically at any rate, and concluded that the limit to altitude was therefore set by the engine. Evidently he was not altogether prepared to be shot at in this particular case, as he left it to Capt. F. S. Barnwell to provide the ninepin, quoting from a recent paper by that famous designer, in which the view was expressed



SAILOR BEWARE! A precursor of machines to span the Atlantic with heavy cargoes, the De Havilland Albatross, examples of which have been ordered by the Air Ministry for experimental flights between the Old and New Worlds, is one of the most striking British aircraft to be seen for many a year. (*Flight* photograph.)

that by going all-out for an altitude record one might reach 61,000ft.

To complete his set-up of ninepins, Mr. Wimperis examined the subject of ultimate aircraft range. He did not arrive at any very definite conclusions except that range is independent of altitude, that the natural limit to range is dependent in high engine economy, low aircraft drag and low structure weight. Rockfeller and Moore have recently published a forecast that a range of 12,500 miles without refuelling may ultimately be attainable. That, of course, is mainly of academic interest except that at one-half of that distance some sort of pay-load will be available, and at one-quarter one may expect quite a useful pay-load, so that it gives some hope of commercial operation of such air routes as the Atlantic—some day.

Analysis shows that the ninepins set up by Mr. Wimperis for future generations to knock down were already sadly depleted when the game started. They were three only, of which the lecturer quoted other people's authority for two: maximum speed 600 m.p.h.; maximum height 61,000ft.; and maximum range 12,500 miles.

From Shore to Shore

THE uninitiated public may perhaps be rather aghast when told that the beautiful D.H. Albatross, of which we publish a photograph above and others on page 413, is to be used for experimental flights across the Atlantic. The man in the street has accepted the idea of *Caledonia* and *Cambria*, because they are boats. Probably most people have heard remarks to the effect that if the flying boats have engine failure they can come down and float on the water, and comfort seems to be derived from that thought. Actually there is nothing at all comforting in the prospect of a flying boat alighting on the Atlantic; it is much better to make it certain, so far as human powers go, that there shall be no forced landings at all. In that case it does not matter, while the craft is making its way across the ocean, whether its landing arrangements are hull or wheels. That factor only becomes important at the start and the finish of the flight. None the less, cases may occur when a boat does add to the safety of those on board.

When flying non-stop across the Atlantic there are certain advantages in a landplane. It must always be possible for designers to make a landplane more efficient from the aerodynamical point of view than a flying boat can be made, and that means that it can carry a greater pay-load than a flying boat of similar size can carry—and pay-load is the crux of the Atlantic question. The flying boat gains on those occasions when it is more convenient, and perhaps cheaper, to use a harbour or a lake instead of a land aerodrome. We thus get the apparent paradox that for Empire routes, which are largely across dry land, the flying boat has been judged the best form of aircraft; while for a purely ocean flight the claims of the landplane are to be examined in a series of test flights. In the experimental stage it is certainly wise to try out both classes of aircraft.

The future Atlantic route is not necessarily always between Ireland and Newfoundland; the Azores-Bermuda route is also to be considered, and at those islands it seems better to use the harbours than to make land aerodromes. On that route the flying boats have an obvious advantage. Large landplanes need large and very firm aerodromes; the water is more accommodating.

The Outlook

A Running Commentary on Air Topics

Australia and Singapore

SIR ARCHDALE PARKHILL, Australian Minister of Defence, who has come to England for the Coronation, is reported to have said that the Royal Australian Air Force might quite possibly be able to supplement the defence of Singapore or the East Indies in the event of war breaking out. The sentiment is admirable, and expresses the spirit which the Empire has come to expect of Australia. At the same time, it is as well to bear in mind that the huge sums of money now being spent on the base at Singapore are not intended just to defend that port and colony. If Australia and New Zealand were not part of the British Empire it is inconceivable that the Home Government should have spent all that money on the Singapore base. In other words, Singapore, as a base, exists rather to defend Australia than as a place which Australia must help to defend. If Singapore were to be crippled by enemy action, then Australia would lie almost defenceless at the mercy of that enemy. For that reason, if Singapore were in danger, the mere instinct of self-defence would impel Australia to send every ship, aeroplane and man which she possessed to its help. But if enemy action took the form of a direct attack on Australia (or, for that matter, on any other part of the British Empire in the Pacific) the strong forces based on Singapore would most certainly make all speed to the rescue.

The R.A.A.F. is one section, and at present not a large section, of the British Empire defence forces in the Pacific. In view of its certain co-operation with the R.A.F. in time of war, it is most desirable that the equipment of both Forces should be homogeneous. It is, therefore, much to be hoped that Sir Archdale will soon discover British types of aircraft which he will consider suitable.

Commercial Airships

DESPITE the great interest aroused by the coming Atlantic experiments with flying boats, it was inevitable that the wonderful records of the German airships *Graf Zeppelin* and *Hindenburg* should turn the thoughts of other nations to the chances of profit offered by commercial airship services. There are rumours afloat of such activity in both the United States and the United Kingdom, but what the outcome will be remains to be seen.

There is one significant statement about both sets of rumours, namely, that any such enterprises must be based on German experience. All the disasters to British and American airships have been traced to lack of experience in design or in handling, or both. Only the Germans have kept up continuity of experience in all forms of airship work, and they have certainly shown that these craft can be flown to schedule with safety. If airships are ever to become a matter for world interest, the blossom will have to spring from German roots.

The commercial airship will certainly be a compromise between the greater comfort offered by modern large steamers and the greater speed offered by modern flying boats. How the public will respond to the offer of such a compromise is unknown. Another unknown factor is the airship's chances of earning a profit. Theoretically, as the cost of production goes down, they ought to be able to pay their way, and it is still equally doubtful whether flying boats will be able to do that. Certainly the interests of transport will best be served by trying out both forms of aircraft on Atlantic services.

Marine Flying

THREE of the senior pilots of Qantas Empire Airways, headed by that trusty veteran Capt. Lester Brain, are coming over from Australia to Hamble, there to undergo the A.S.T. course in the handling of flying boats. Soon, of course, Qantas Empire Airways will have to take charge of the service at Singapore, although Short boats will continue on to Darwin and Sydney. Perhaps it will not be very long before the service is extended across the Tasman Sea to Auckland.

This recalls the very fortunate, but all the same remarkable, fact that in all the many landplane flights from England to Australia, starting with the Vimy flight by Ross and Keith soon after the Armistice, there has been no case of an aircraft being lost in the Timor Sea. One would not expect that a four-engined machine would be forced down there or anywhere else, but since Bert Hinkler's Avian flight there have been innumerable crossings by small machines with single engines. But the use of a boat does add to the safety of all on board.

With the prospect of extending the use of boats to circle the world on a British Empire route it begins to seem strange that pilots should have to come all the way from Australia to England to learn the mysteries of handling marine aircraft. At Singapore there is a seaplane club, and it is really rather strange that there are not more of the same sort in the Empire. With a small float seaplane the rudiments of landing, taxying, mooring and taking off in all conditions of wind and tide can be learnt, and that knowledge would apply when the time came to learn to handle large flying boats. The Governments of the various Empire countries would do well to consider the wisdom of giving subsidies to seaplane flying clubs.

A Fashion for Fighters

THE most notable machines at the last Paris Show were twin-engined fighter-bomber-attack-reconnaissance types by Potez, Hanriot and Fokker. The Potez and Hanriot, like other models under construction by various concerns, including Breguet and Romano, were, one gathered, regarded primarily as fighters (although their layout made for great versatility), and as such marked a new trend which will undoubtedly be followed by other nations.

Italy, with the Breda 88 fighter-bomber, has shown what excellent performances are offered by well-designed twin-engined machines (the Breda covered 100 km. at an average of 321 m.p.h. and 1,000 km. at 295 m.p.h.), and in the light of our experience with such machines as the Blenheim we should be able to build ourselves something quite outstanding.

It remains to be seen if the new twin-engined machines will continue to function purely as fighters after entering service or whether they will assume other roles, like the famous *multiplaces de combat*, which now appear to be considered as straightforward bombers.

Fait Accompli

THE following is a direct quotation from the lecture delivered by Mr. George J. Mead, A.F.R.Ae.S., last week and summarised on pages 414-418:

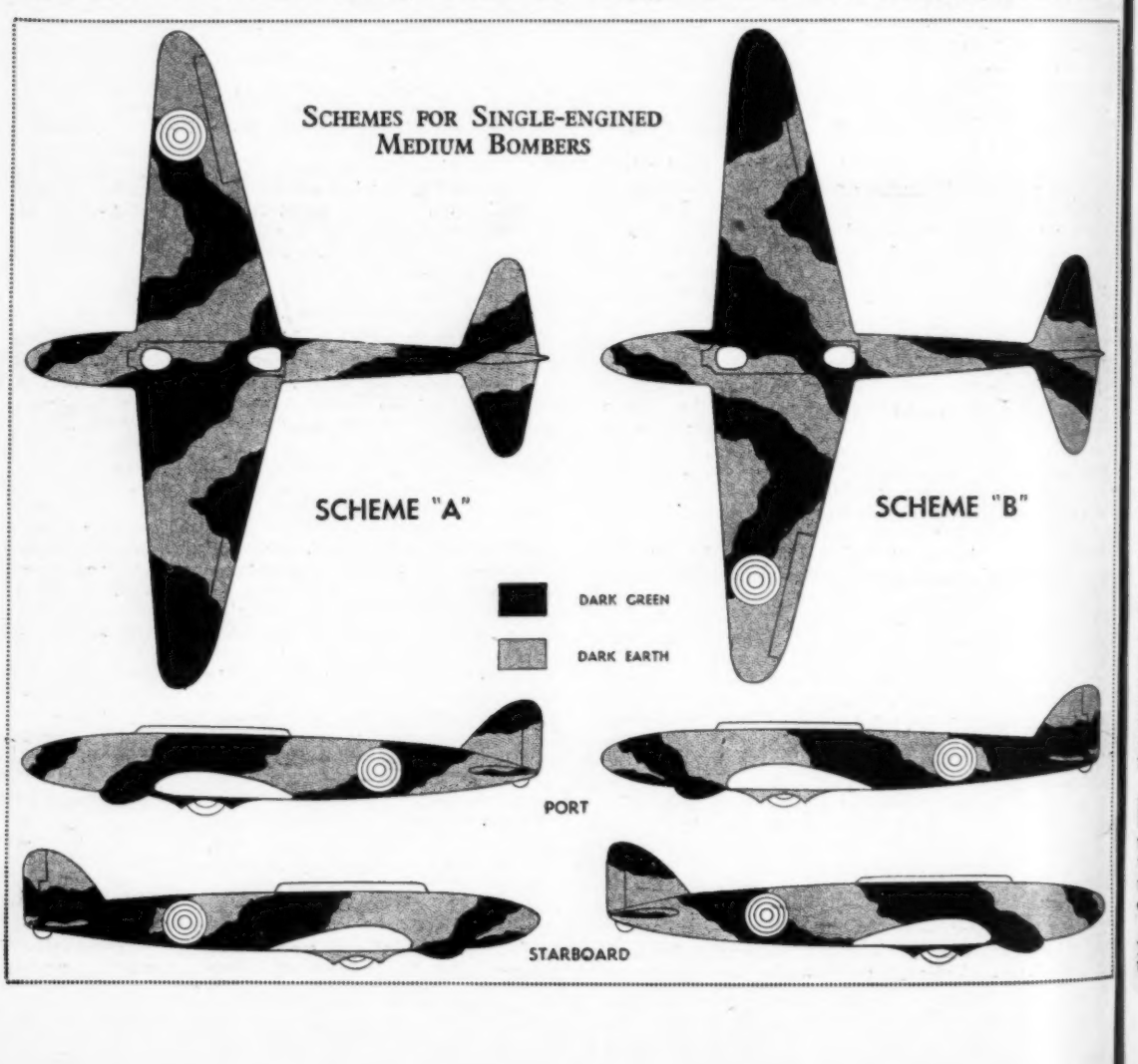
"... the best alternative to submerging the engine in the wing would be to reduce its cross section to the minimum and utilise it as the propeller support."

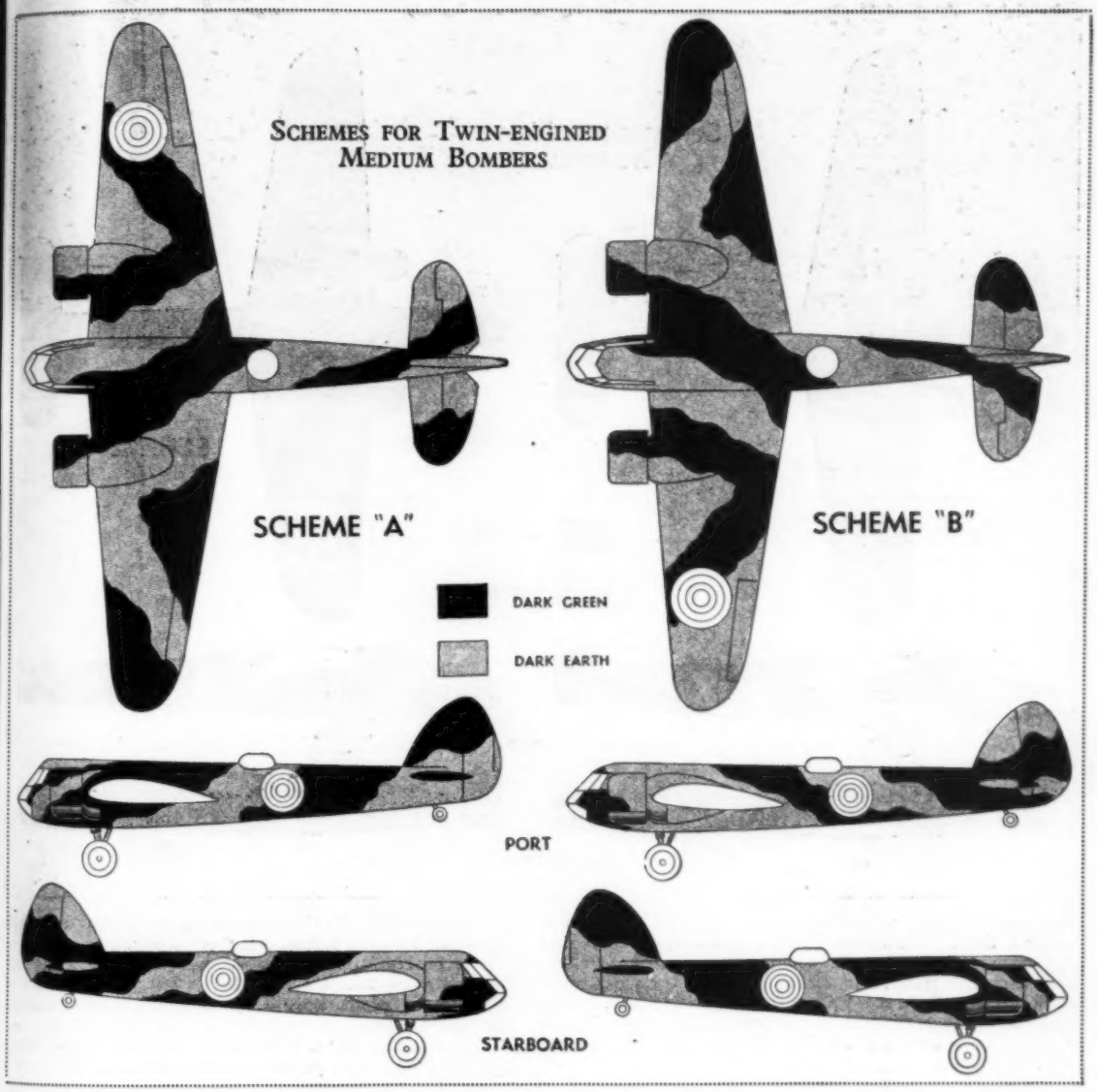
Those desirous of seeing such a scheme *in practice* are recommended to study the photograph opposite.

"Shadow Shading" Adopted by the Air Ministry : The Official Schemes Illustrated : War-time Dazzle Painting Recalled

THE Air Ministry has decided that all medium bombers, heavy bombers, and Army co-operation aircraft in production for the Royal Air Force shall be camouflaged with one of a number of schemes of "shadow shading" lately evolved for the various classes of machines by their experts. Photographs have already appeared in *Flight* showing the Handley Page Harrow, Bristol Blenheim and Vickers Wellesley in their new coats, and something of the bizarre appearance of these machines thus treated will have been gathered.

In future there will be regulation schemes for single-engined medium bombers, twin-engined medium bombers, heavy bombers, and army co-operation machines, each class being allotted two alternative systems of colouring, one being the "mirror image" of the other. These variations are reproduced herewith (with the exception of the "A.C."





schemes) by special permission of the Air Ministry).

Briefly, "shadow shading" implies the application of large, irregularly shaped patches of dark green and dark earth colouring to the side and upper surfaces of an aircraft, the lower surfaces being finished in a dull black effect known as "night" with a view to deadening the reflections of searchlights. The treatment is very thorough and embraces such items as spinners, undercarriage struts and axles, and wheel centres, although exhaust stub-pipes and manifolds and tail pipes are not treated. Airscrew glint is being suitably subdued.

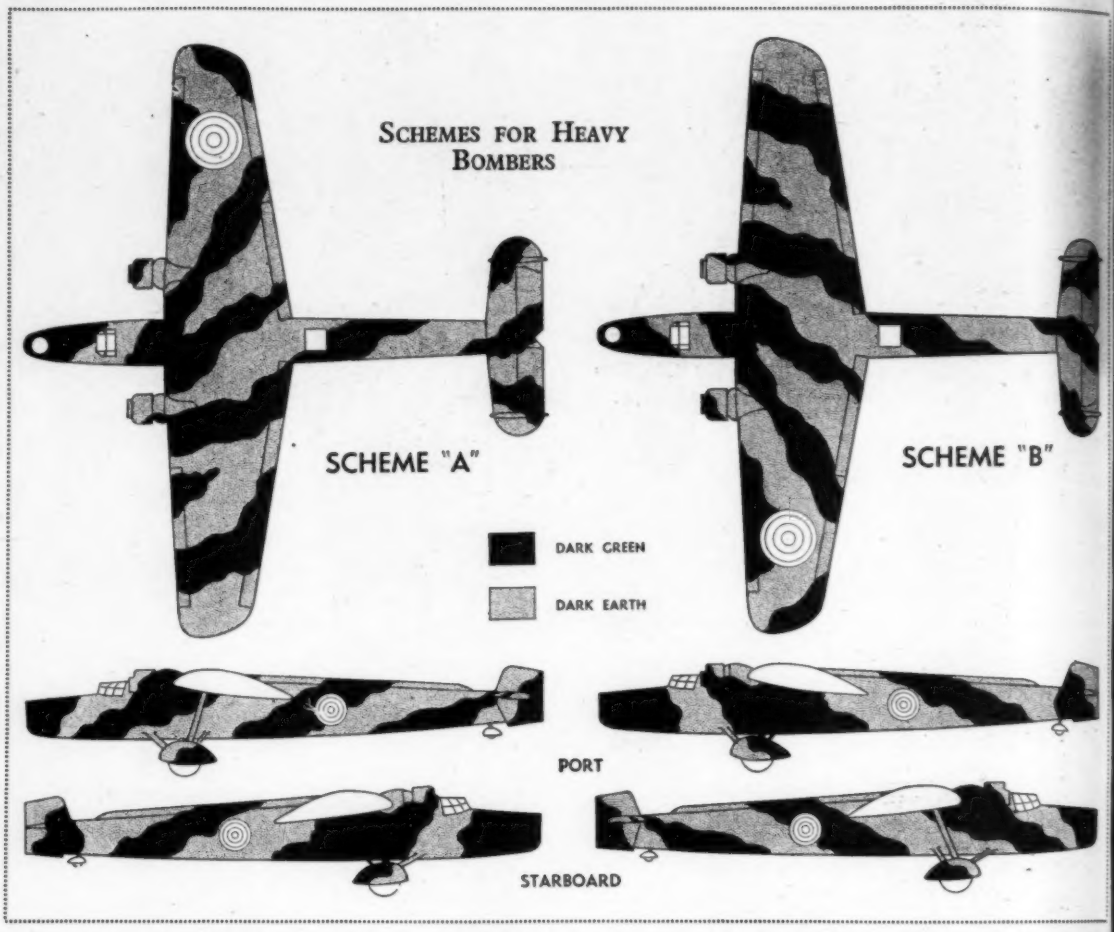
Metal parts are treated with matt cellulose finishes and primer or matt pigmented oil varnishes and primer, it being unnecessary to use other organic protectives under these materials. The materials used for fabric-covered portions are non-tautening, and the required tautness of the fabric must be obtained by increasing the number of coats of red dope.

It has been found necessary to add a concentric ring of yellow to the periphery of the R.A.F. target on machines treated with "shadow shading."

The revival of camouflage for war machines (Great Britain is by no means the only power to specify it) recalls the schemes which appeared spasmodically during the war years. Germany made the most extensive practical use of camouflage, and developed some amazing systems.

The first principle observed by the Germans was to paint upper surfaces dark and lower surfaces light, closely following the natural colouring of animals and birds. A simple model of a bird painted dark on the top surface and brilliant white beneath, with light falling on it from above, is perfectly invisible when seen from a short distance against a background of neutral grey. The under surfaces of German machines were usually white, pale blue, turquoise blue, or pale blue-green, except where special camouflage schemes were used.

For upper surfaces the Germans followed two principles: either they employed schemes of "cryptic mimicry" (painting surfaces in streaks or patches of dark green, dark brown or russet, in the hope that they would take the colours of the earth below), or they used a scheme, probably more scientific, following closely the results of investigations by French impressionist artists ("pointillism"), in which very small patches of pure colour were



supposed to mix with the surroundings or blend into neutral tints. For aircraft use they employed polygons of blue, rose, yellow, green, and mauve for under surfaces, and a similar pattern in black, dull green, dark purple, dark blue, and brown-yellow for upper surfaces. This pattern was further disturbed by bold black stripes following the tape covering the ribs and on the leading and trailing edges.

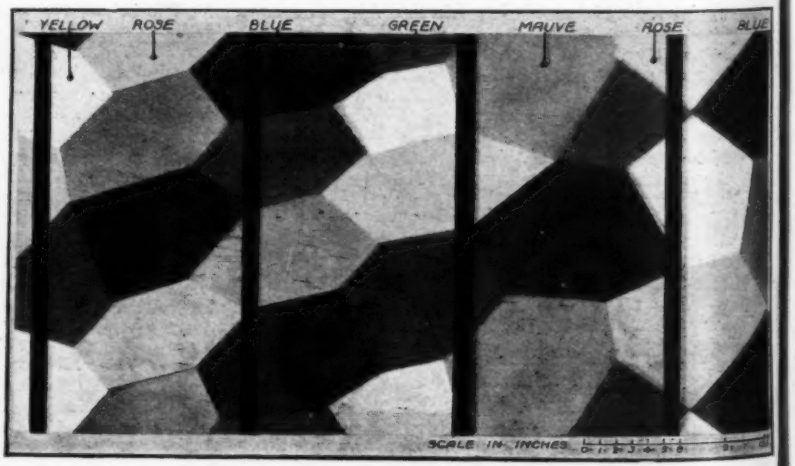
For night bombing on the Gotha A.B.5 they used similar patterns, but somewhat larger, in black, dull green, dull blue and wine, all over the machine. Sometimes this scheme was modified into a pattern of perfect hexagons, as on the A.E.G., in which case the colours were further disturbed by irregular blotches of black.

The most generally used colours for camouflage were deep browns, greens, and russets applied sometimes in definite strips dividing a top surface, say, into three equal parts, or, as on the Fokker Triplane, smearing them uniformly over the entire surface.

In some cases the application of colours was transparent, and the colour was evidently disturbed or partly washed away with sponges. In other instances it was opaque.

The nearest approach to the new Air Ministry system was used on the Albatros G.37, where the patches of greens and browns were irregular and the under surfaces were pale blue.

The Austrian Berg, with special reference to the sandy soil of Istria, was painted sandy yellow in transparent colour.



An involved "Patchwork Quilt" system of camouflage used by the Germans during the War.

Topics of the Day

More Autogiration . . .

SINCE, at the time of writing these comments, all but half an hour of my week's flying had been carried out as a somewhat stupid pupil in an Autogiro, I make no apology for returning to the subject of rotating-winged aircraft and their development. For many reasons it is good for one's soul to be put back in the "First Form" and to be forced to learn and unlearn a great many things. In this case my instructor has been brought up almost exclusively on Autogiros, and it was not much good saying, "Please, Sir, this is what I do in ordinary aeroplanes." To him the Autogiro is an "ordinary aeroplane."

However, after an hour and a half's dual I feel almost ready to do a little fine-weather soloing, and I am more than ever convinced that this often-maligned machine has more than the makings of something really good. The trouble is, of course, that it has been flown by so many fixed-wing experts who have declined to unlearn anything or to admit that they did not know everything about flying; they have just gone about the place crabbing the machine. Most of my time has been spent in learning to move the right levers in the right order, and only now is my mind almost free to cope with the real business.

The Autogiro people themselves admit that the C.30 is far from perfect and that it is only a stepping-stone towards better things. To mention only one or two points: the weight could be greatly reduced and the take-off improved by a hundred per cent.; the mechanical effort of running up the rotor and so forth could be simplified; and the forward view made somewhat less restricted during the vertical approach process.

All that with the machine as it is at present. The direct-start model, now being developed with a three-blade rotor, will provide a no-run take-off and, since the blades automatically return to a negative angle of incidence immediately after the machine has touched down, many of the landing and ground-handling difficulties will have been done away with. In the present type it is necessary to abide strictly by the rules—turning left out of wind immediately after landing, applying the rotor brake when facing down-wind, and so on—if expensive mishaps are to be prevented, and the majority of the minor accidents have been caused by carelessness in these and similar little matters.

The work involved in running-up the rotor has already been experimentally done away with in a pneumatically operated system whereby the pilot merely turns a few conveniently placed knobs on the dashboard. The C.30 is very sensitive to fore and aft trim and the lever for this operation is placed on the right, but there should be little difficulty in developing a scheme whereby the work could be done quite effortlessly—or even automatically.

Auto Instruction

SO far as training is concerned the Autogiro instructors are in a very difficult position. Absolute newcomers must be taught how to fly and to land in a machine which is particularly sensitive to wind direction and which is somewhat complicated in comparison with the normal aeroplane. Yet there are a surprising number of exclusive "A" licencees in this country alone, and I have met at least two who state quite firmly that they would never fly anything else if they could help it. On the other hand, confirmed fixed-wing pilots must be patiently made to forget quite a number of things which they have previously learnt and to do as they are told. Furthermore, the rear stick has more leverage than that in the front, so the instructor sometimes has a Samsonian struggle with any obstinate pilot who thinks he knows all about it and who is himself sound in wind and limb.

. . . And Autorotation

FEARFUL that the Autogiro efforts might have upset my minor fixed-wing efficiencies, I sallied forth during the week-end to do battle with a club aeroplane—and, incidentally, to try a piece of navigational gadgetry in an open cockpit aeroplane.

It must be admitted that there is a lot in this open machine business—provided that the weather is reasonably good. As soon as I had screwed down the Sutton harness as tightly as it would go, so that I felt part and parcel of the machine, the long-dead aerobatic urge came over me. One day I must ask a psycho-analyst why one is straight-and-level minded in any closed machine.

After reaching 2,000 feet and gaining a matter of another 500 feet in a series of Hendonesque steep turns (much to my surprise and mental comfort) I went through my little repertoire of aerobatics. Although always claiming in a loud voice that an aeroplane is meant only to go from A to B and not to be flung violently about the sky, I must say that there is nothing to touch this aerobatic business for regaining self-confidence—particularly if a deserted sky and aerodrome allows one to complete the private display by an exaggerated forced-landing approach.

Incidentally, I often wonder whether it is realised how much height is lost at the beginning of a spin. At 3,000 feet it all seems to be very precise and simple, but that initial stalled turn, before the stick flicks over, has killed lots of people when it occurs accidentally on a final gliding turn towards an aerodrome. Allowing for lag in the altimeter reading, it seemed to me that my machine lost as much height in that first tumble as it did in one turn of the real spin. A violently stalled turn produced a loss of nearly 300 feet, while this and the two turns only showed a total loss of 600 feet. I await correction. A sensitive altimeter would help.

INDICATOR.

Private Flying

FROM the CLUBS and SCHOOLS

YORKSHIRE

CLUB aircraft flew 25 hr. 35 min. during the week, and flights were made to Heston and Scarborough. Mr. Leach has gone solo.

REDHILL

Four new members joined last week, and the flying times amounted to 54 hr. 30 min. An Aeronca demonstration will be given to-day.

LONDON

The flying time for last week was 90 hr. 50 min. New members include Messrs. E. D. Brierly, D. Broom, O. M. Ryan, B. Cartwright, G. H. Woodhouse and G. P. Moss.

YORK AND LEEMING

Hours for the month to the 25th totalled 92 hr. 15 min. Messrs. R. Barwick, Gomersal and Pinches have joined as flying members, while Mr. Duncan Brown and Mr. and Mrs. Gladish have joined as club members. Mr. Barroclough made his first solo.

CAMBRIDGE

Flying times at Marshalls' Flying School for the week ended April 25 totalled 76 hr. 10 min. Messrs. Pringle, Timpson and Fuller have joined the School. Mr. Wallis has passed the cross-country and the general flying tests for his "B" licence.

SOUTH COAST

Rather better weather enabled some 36 hours' flying to be done at the Club—including several cross-countries. Mr. Legge and Mr. Foord have started flying, and Mr. Howell has passed the test for his licence. There is one new member—Mr. G. T. Boutall.

KENT

New members are Messrs. Harvey, Love and Atkins, who have already started flying instruction. The Praga, which is on loan to the Club, is proving very popular with the members. Coronation Air Displays are performing at Bekesbourne aerodrome on May 6.

C. A. S. C.

During last week-end improved weather conditions at Cambridge produced two first solos, those of Messrs. A. G. Drew and E. K. Gabb. The total flying time was 10 hr. 30 min. Mr. E. B. Driscoll has taken his first flight to qualify for probationary membership of the Corps.

MIDLAND

For the week ended April 23 flying times totalled 9 hours dual and 9 hr. 35 min. solo and passenger. New members who have joined during the week are Messrs. R. W. D. Danielsen and D. Onions (flying), and Mrs. D. W. Anger and Mr. A. W. Seedhouse (ordinary).

NOTTINGHAM

The total flying time for the week ended April 15 was 23 hr. 45 min. with three machines in service. Cross-country flights were made to a number of aerodromes and eighteen machines visited Tollerton. Miss Hazel Phillips and Miss E. Richardson have joined the Club as associate members.

HANWORTH

Members of the London Air Park Flying Club flew 94 hr. 55 min. during the week. New members are Mr. Dunphy, Mr. Smithyman, (a Canadian member of the Air League of the British Empire), Mr. Tressler and Mr. Brown. Mr. F. Reekie has passed his "A" licence tests, while Mr. Welsh has gone solo.

SOUTHEND

As from May 1 the Club will be flying seven days a week and will not be closed on Mondays as heretofore. An extensive programme has been arranged for Coronation week, including daily flights over the Fleet. Last week was an excellent one for flying and the machines were kept busy the whole time.

YAPTON

Flying times for April to the 24th were 99 hr. 30 min., the weather being very good. Visitors included the Duke of Richmond in his Autoplane and Mr. Christopher Clarkson in a Vega Gull. New flying members are Mrs. D. Speranza and Messrs. I. S. C. Henderson and Arthur Gadie, all are taking the £15 "A" licence course. Mr. Dennis Holland has obtained his "B" licence and Mr. R. F. Aitken his "A."

CINQUE PORTS

During the week Mr. Brand successfully passed his final tests at Hendon and is now a fully qualified "B" licence pilot, while Mr. R. M. Hackney has started his tests by completing the cross-country flight from Lympne. A new member to join the Club is Mr. Wallace, who is taking his "B" licence. The workshop have taken on extra labour in order to cope with the increase of C. of A. work on private owners' machines.

NORFOLK AND NORWICH

The improved flying conditions, coupled with the longer evenings, have brought an influx of flying members, and on Saturday, April 24, no less than 15 hr. 35 min. were recorded. Mr. Robertson, of the commercial school, has passed his "A" licence tests, and Mr. L. Fawcett has gone solo. The entries for the Public School Boys' Aviation Camp continue to increase, and it would seem that a record number of boys is to be expected during the period of a month in which the camp will be open.

BROOKLANDS

Club machines flew 115 hours last week. Flt. Lt. Bremridge, A.F.C., is taking over the management of the sales department as from April 26. Machines demonstrated during the week were the Vega Gull, Porterfield and Wicko, while an interesting visitor was the Zlin of the Bata Shoe Factory, Czechoslovakia. On Sunday next, May 2, the Brooklands Flying Club is doing its share of Coronation entertaining. A party of fifty overseas visitors are being brought down to look round the aerodrome premises and be entertained to tea by the Club. The cross-country competition was won by Mr. Symondson.

KARACHI

Flying times in March reached the gratifying figure of 268 hr. 40 min. It is noteworthy that this includes a considerable amount of night flying, i.e., 11 hr. 35 min. dual and 21 hr. 15 min. solo, and also that cross-country flights totalled 27 hr. 20 min. Mr. Chitamber has successfully completed his training as a pilot instructor, and Mr. V. R. Jadhav has passed his "A" licence tests. Two officers of the Civil Aviation Department visited Karachi to discuss pending matters in connection with the seaplane base to be constructed at Keamari; they inspected the site for the base by night flying in the Club's aircraft, while the aerodrome officer carried out night flying for the inspection of the aerodrome lighting system at Drigh Road.

BORDER

The event of major importance during the week was the Dawn Patrol last Sunday, which was a great success in every way. The weather was absolutely perfect, and attacking machines came from Edinburgh, Newtownards, Liverpool, Wallasey, Sherburn, Woodford and Yeadon. The defending aircraft were the three machines of the Border Flying Club, a Hillson Praga from Liverpool, a Taylor Cub from Peterborough, and the Miles Whitney Straight with Mayo engine. Of the defenders the slower machines circled the airport about two miles away, medium-fast machines about five miles away, the Straight covered the northern section outside the ring, and the Club Hornet covered the southern section outside the ring. This defensive scheme worked well, and all but one of the attackers had their numbers taken. Over sixty people sat down to breakfast. The Civic Flight, organised by Mr. Harold Carr, the president, was also very successful. This year the party flew to Belfast, where they were entertained to lunch by the Lord Mayor and afterwards shown the sights. New members are Mrs. Henderson and Mr. J. T. Wills.

From the "Popular" Angle

The Airman and the Air. By A. B. Fielding. Price 5s., Sir Isaac Pitman and Sons, Ltd.

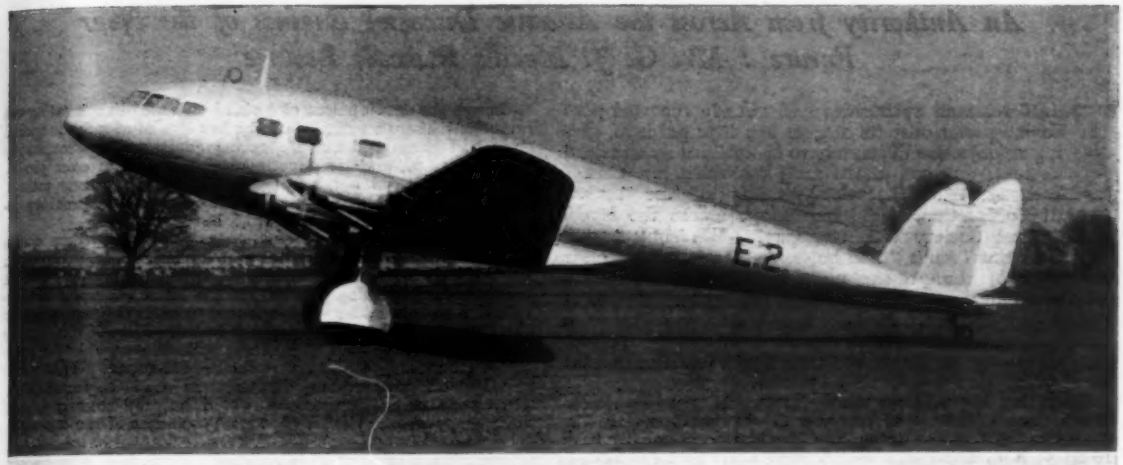
THE author deals with some of the less common aspects of "popular" aeronautics, and interesting information is contained in the early chapters on air, wind, clouds, and weather and bird and insect flight. The design and construction of aircraft and engines are reviewed from the elementary angle, and news items and historical facts pop up here and there. The book concludes with a short list of flying terms and notes on outstanding flights of the world.

More Ground Training

IN the past few weeks two other pupils have joined Mr. Rawnsley, of the County Flying Club, as ground-trained pioneers. These are Messrs. C. St. L. Jervis and W. M. Fraser—the latter being the secretary of the club. Both have reached the stage of carrying out flights up to half-an-hour's duration and up to a height of 1,000ft., and each has been through the normal Kronfeld ground trainer and flying trainer course.

The club charges 10s. an hour for the trainer and 15s. an hour for the Drone, so—since they have each had an average of 3 hours on the ground trainer, 2½ hours on the flying trainer and 2 hours on the Drone—their flying expenses have totalled £4 5s. in all. Which can hardly be considered excessive.

WORTH WAITING FOR: THE D.H. ALBATROSS



The D.H. Albatross posed for photographs to show such features as the installation of the four Gipsy Twelves with their amazingly compact cowlings and leading-edge intakes for the cooling air, the retractable undercarriage and the general aerodynamic excellence of the whole machine. (*Flight* photographs.)

POWER PLANT TRENDS

An Authority from Across the Atlantic Discusses Engines of the Near Future : Mr. G. J. Mead's R.Ae.S. Lecture

THAT research authorities had already reported aero engine power outputs of over 100 h.p. per litre, giving an objective ultimately to be attained by standard engines, was one of the facts on which Mr. George J. Mead, A.F.R.Ae.S., vice-president of the United Aircraft Corporation, based his lecture before the Royal Aeronautical Society last Thursday. His subject was "Power Plant Trends," and he gave a commendably clear statement of the present position, expounding equally lucidly his ideas on the most likely courses of future aero-engine development. As Mr. Mead's company embraces the Pratt and Whitney and Hamilton Standard concerns, his views on power plants and their applications were most acceptable.

Examining the progress made during the last decade to obtain some indication of probable future developments, Mr. Mead recalled that the output per litre had risen steadily from 18 to 35 h.p., crankshaft speeds from 1,900 to 2,800 r.p.m., take-off mean effective pressures from 132 lb. to nearly 200 lb., cruising pressures from 90 lb. to 135 lb., and inter-overhaul periods from 300 to 600 hours.

The use of fuels with higher anti-knock ratings, additional displacement, better cooling, greater boost, higher operating speeds and lower fuel consumptions might confer higher performances upon standard-type engines.

On the question of fuel Mr. Mead explained that authorities had not yet agreed as to the precise effects of better fuels on engine performance. Experience showed that the better grades of fuel not only gave superior performance but reduced maintenance costs to such an extent as to more than justify the higher fuel cost. During the latter part of 1936 several American transcontinental lines started to use 100-octane fuel for take-off because of the greater pay-loads which could be carried. The general adoption of 100-octane fuel could be safely predicted.

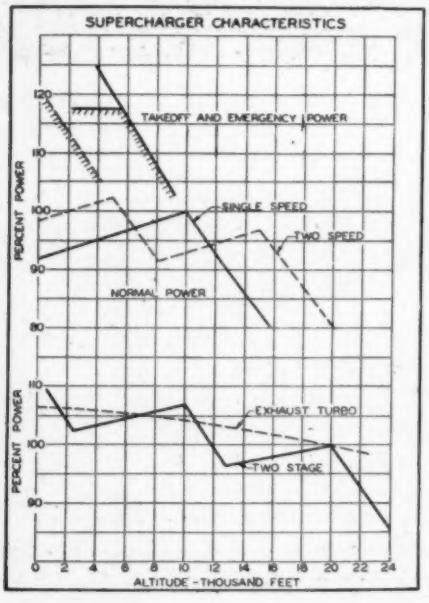
Experts were far from unanimous on the probable course fuel development would take. Most of the more common petroleum derivatives had already been investigated and exploration of the less familiar hydrocarbon groups was under way. A new measuring stick was needed, as the octane scale ended at 100. The bouncing-pin system of knock measurement was found to be wanting in the case of higher knock ratings. A method devised by the U.S. Army Air Corps in which temperatures were substituted for pressures seemed satisfactory. Although the development of fuels of high anti-knock rating was important, there seemed to be another line of attack, as special fuels had been produced for racing engines of approximately 300 lb. m.e.p., and for experimental cylinders of over 500 lb. m.e.p., which did not have particularly high octane ratings. It seemed probable that fuels giving equally satisfactory results at commercial prices might be developed.

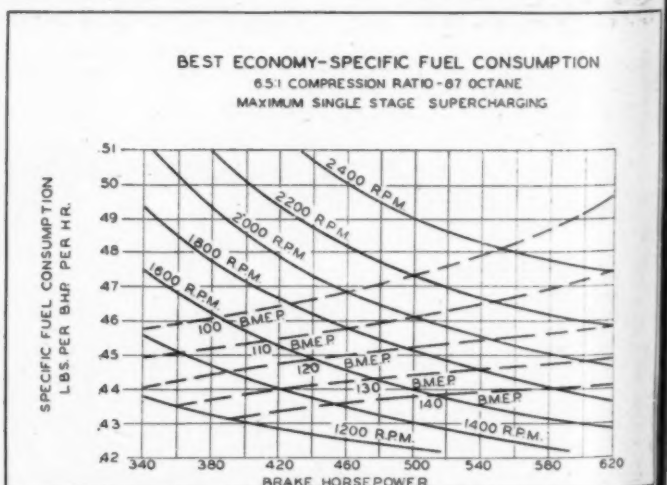
In the development of existing engine types there was a trend toward smaller cylinders and higher speeds. Maximum performance was being secured with the total displacement reduced from 10 to 15 per cent. in the latest examples of nine-cylinder radials and twelve-cylinder vees. The exception to the general trend was the two-row radial. Here it was feasible to use eighteen instead of fourteen cylinders providing a satisfactory built-up crankshaft could be developed. This would provide an increase in displacement and correspondingly greater power. The diameter would be only slightly greater than the fourteen-cylinder type with cylinders of the same size.

Cooling

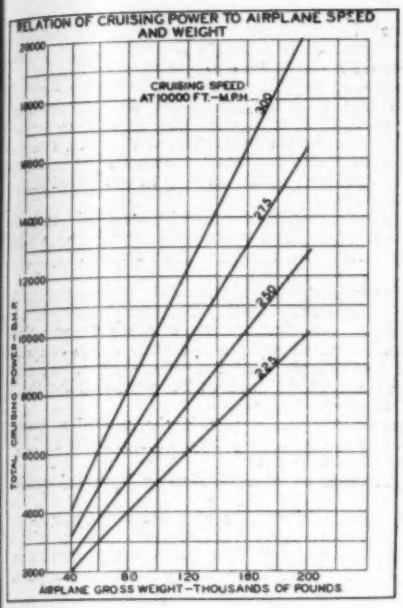
Mr. Mead mentioned, in his remarks on cooling, the increase in fin area lately necessitated and the advent of low-drag cowlings and controllable cooling. The comparatively low weight of the air-cooled engine had brought it into universal transport use in the U.S.A. Further improvements must come from increasing the mass flow over the cylinders. Blower cooling would permit considerably higher power to be taken from air-cooled engines. As it was possible, with liquid cooling, to maintain uniform temperatures over the combustion chamber and that portion of the cylinder traversed by the piston this might be a deciding factor. The air-cooled cylinder had the advantage of greater temperature difference between cooling air and cylinder, but correspondingly profited less from the reduced atmospheric temperature at altitude. Further improvement in liquid cooling centred on the elimination of thermal stresses in the cylinders and on better provision for heat transfer. A great deal could be accomplished along these lines by applying the lessons learned from air-cooling.

Only about half the combustion chamber could be cooled by the cooling medium flowing over it, the piston head being the largest area in the combustion chamber not cooled by the slipstream. The major part of its heat dissipation was through the piston rings to the cylinder barrel, and for this reason the number of rings had increased as power and temperature were raised. Pistons were further cooled by oil thrown off the

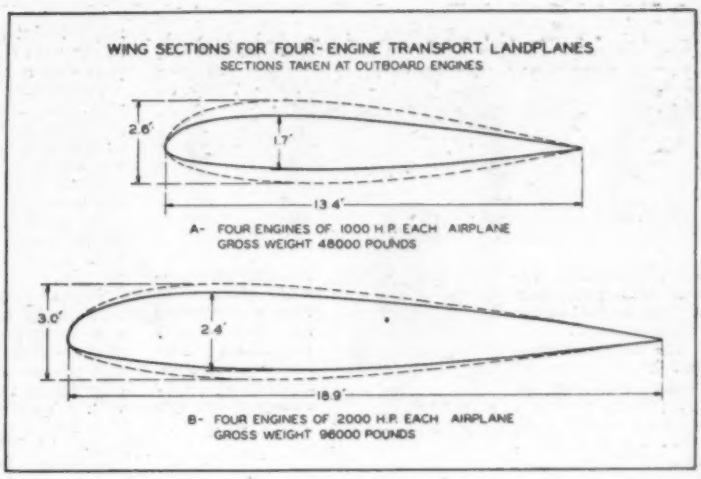




The left-hand graph throws light on the performance of two-stage and exhaust-turbo superchargers, while its companion should be of special interest to the commercial operator.



(Left) This graph may be regarded as a forecast for the immediate future.



In view of the proposals to "bury" engines the above diagram is of particular interest.

cranks, and under-crown and skirt fins had been added. This heat flow accounted for the increase in oil-cooler size.

Great improvement in exhaust-valve cooling had followed a new forging technique allowing chemical filling of both stem and head. Inlet valves were cooled by the induction mixture.

Smaller spark plugs with longer reach had helped a little in their cooling problem which had lately been intensified by screening," said Mr. Mead. The increasing difficulty of oiling-up when idling of plugs designed for high-temperature operation led him to predict, shortly, a more positive method of cooling.

Superchargers, now used for increasing take-off power as much as for high altitudes, were, for compactness and simplicity of mixture distribution, chiefly of the engine-driven centrifugal type located between carburettor and cylinders, but this practically prohibited intercooling. The mixture temperature, a function of the impeller peripheral speed, limited the amount of boost in the absence of an intercooler, and where two-speed drives had been used to lower the take-off temperatures, improved ground-level and high-altitude performance had been offset by loss at operational altitudes. Fuel consumption was raised when using the higher gear ratio. There could be little further single-stage development without intercooling, and the practical advance expected to permit higher operational altitudes was a two-stage blower with cooler between stages. Ideally, regulated supercharging with infinitely variable impeller speeds was required; this with intercooling that did not affect distribution. The exhaust-driven turbo-supercharger, possibly used with direct fuel injection, was attractive for commercial use in essentially meeting these requirements. It also reduced exhaust noise.

Con-Rod Difficulties

Engine operating speeds were limited by valve gear and crank pin loading, 2,700 r.p.m. being near the limit for a push-rod-operated two-poppet-valve head. Overhead camshafts, which were more applicable to in-line engines, allowed higher speeds. Connecting-rod bearing loads were also becoming a limiting factor, particularly in radial engines, and connecting-rod systems would have to be made lighter and better bearing metals used.

Very low specific fuel consumptions demonstrated on the dynamometer were not necessarily feasible in operation due to cooling problems, now more acute at cruising speeds than at take-off or in climb. Average specific fuel consumption for single-row radials, as used in the United States, was 0.46 lb./b.h.p./hr. at 75 per cent. power on 80-octane fuel with 6:1 compression ratio, and for two-row radials on 87-octane fuel with 6.5:1 compression ratio, 0.44 lb./b.h.p./hr. at a slightly lower power percentage. The difficulty of measuring power development in flight had almost been surmounted by the new Pratt and Whitney torque meter measuring from the airscrew fixed reduction gear.

The raising of compression ratios was the best method for lowering specific consumption, but detonation limitations of the fuels had hindered progress. Ratios of 6½ or 7:1 were now standard with 87-octane fuel and 7½ or 8:1 were to be expected with 100-octane fuel; improvement was made up to at least 9:1 ratio. Sleeve valves were conceded to enable the use of one integer higher in compression ratio than poppet valves operating on the same fuel. Each added integer had the advantage of raising power output by 5 per cent., but if power increase only was required the use of greater boost was a better method due to the lower maximum pressures involved.

As the leanest cylinder limited performance, equal distribution had a definite bearing on consumption. Excellent radial consumptions were possible due partly to the symmetrical intake system, and direct fuel injection held promise of a further improvement. Engine operational and mixture conditions could not be accurately determined and adjusted even with the use of an exhaust-gas analyser, but the Pratt and Whitney automatic mixture control in conjunction with constant-speed airscrews maintaining fairly low speed and high m.e.p. gave mimimum fuel consumptions.

Single-Sleeve Valves

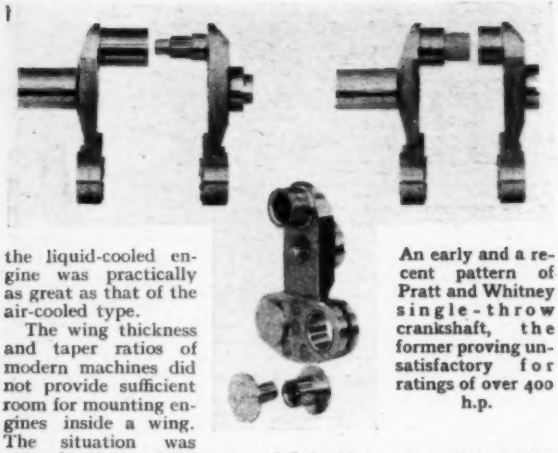
The advantages of the single-sleeve valve were the reduction of combustion chamber temperatures, due to the elimination of exhaust valves, the higher operational speeds and the higher compression ratios permitted. Mr. Mead doubted if volumetric efficiency was materially bettered because of the limitations of sleeve travel and port flow characteristics. The difficulty of fabricating interchangeable sleeves had slowed development, but splendid work had been done by Mr. Fedden and Mr. Ricardo, encouraged by the Air Ministry.

The trend of development was towards smaller cylinders, more in number, with higher boost and crank speeds; the result would be great thrust power in relation to form drag and smoother operation with longer life and lower costs. Considerably greater engine power was required and a balance needed to be struck between speed, size and revenue. Engine size depended upon the number per aeroplane, but two was thought to be the minimum. Airlines scheduled at 75 to 90 per cent. power had been late quite half the time, and overhaul periods were about inversely proportional to the percentage of power used. A four-engined aircraft scheduled on 65 per cent. power was a good combination, and there was a 15 per cent. power reserve with a dead engine. Load distribution and wing cover by the slip-stream for take-off were favourable with six engines.

Land aircraft of 100,000 lb. with 225 m.p.h. cruising speed were to be expected, and the necessary 5,000 b.h.p. for cruising meant engines with a take-off power of 2,300 on a four-engined basis, and even more might be needed for flying boats. Importance of take-off power to pay-load had led to a rating approximately 20 per cent. over the cruising power.

In discussing power plant drag Mr. Mead stated that form and cooling drag absorbed about 25 per cent. of the thrust horsepower for a 48,000-lb. machine with air-cooled engines and conventional cowlings at a cruising speed of 225 m.p.h. at 10,000ft.

In most installations to date the total power plant drag of



An early and a recent pattern of Pratt and Whitney single-throw crankshaft, the former proving unsatisfactory for ratings of over 400 h.p.

the liquid-cooled engine was practically as great as that of the air-cooled type.

The wing thickness and taper ratios of modern machines did not provide sufficient room for mounting engines inside a wing. The situation was somewhat better in the case of flying boats with their higher power loadings. A possible solution for the landplane was the use of thicker sections. Since the entire wing need not be made deeper the average profile drags would rise by only about 12 and 6 per cent. in the cases of two four-engined transport machines of 4,000 and 8,000 h.p. The airscrew support was estimated to absorb 4 per cent. of the power.

Mr. Mead believed that it would be possible to reach engines during flight only with wing thicknesses of five or six feet. Reduction in wing area was making the problem more difficult.

The disadvantages of placing engines inside a wing were primarily due to the disturbing effect on normal balance through moving the engines so far aft, to the effect on the wing structure and to the impaired engine accessibility.

Airscrews should be placed approximately one-half their diameter ahead of the wing, the wetted surface of the nacelle then being a function of airscrew location rather than of engine length. The best alternative to submerging the engine within the wing might be to reduce the cross section of an engine to a minimum and utilise the engine as an airscrew support. There was ample room for even the longest engine between the airscrew and the forward wing spar or the box in monospar construction.

Cooling Drag

Commenting on problems of cooling drag Mr. Mead said that surface radiators, which he regarded as the ideal solution in the case of liquid-cooled engines, might be less attractive if it were possible to achieve a minimum figure of 5 per cent. of the thrust horse-power in overcoming cooling drag with what he called submerged radiators.

Discussing cooling problems met in standard installations of air-cooled engines, the lecturer thought that further refinement in cowl shape and air passages gave promise of additional reductions in drag, particularly at cruising speeds, although it has become necessary to increase the mass flow of air.

It seemed probable that the cooling drag for air-cooled engines of small frontal area used as airscrew supports or submerged in the wing would be of the order of that required for liquid-cooled engines with submerged radiators. This conclusion was reached on the assumption that a forced flow of cooling air could be provided in which the entry and exit for the cooling stream was so designed as not to cause interference or form drag.

A reduction of at least half the drag of present commercial installations could be expected, which meant a reduction in power required of 12 per cent.

A propulsive efficiency of 88 per cent., although possible under proper conditions, was readily impaired with consequent penalty to operating expense.

Mr. Mead thought the most efficient airscrew arrangement was a single airscrew of adequate diameter for each engine.

Weight alone, said Mr. Mead, was not a true criterion, but rather its effect on the overall efficiency of an aircraft. The constant-speed airscrew, for example, weighed 20 to 60 per cent. more than the fixed-pitch, but permitted taking off 10 to 30 per cent. greater gross weight.

He saw no real opportunity for materially reducing the specific engine weight at the moment. Some operators were already thinking in terms of 1,500 to 2,000 h.p. engines, which might be interpreted to mean that such units would be needed in the next five years, while power plants of twice these outputs were not far off if recent trends were continued.

Considering types of engines which might offer greater outputs, Mr. Mead said that the maximum cylinder size had probably been reached already and the trend was toward smaller bores. He was of the opinion that the 5½in. cylinder was the best compromise at present between output and cost. Outputs of 47 h.p. per litre would no doubt be achieved during the next five years.

No more than nine cylinders could be used with a solid master connecting rod and no more than seven with a split rod. There was a tendency to reduce the number of cylinders per pin.

Present practice indicated that at least six throws per crankshaft could be satisfactorily used. Torsional vibration was a difficult problem. Americans were working to variations of plus or minus ½ deg. within the operating range of speeds and powers for their single- and two-row engines. Presumably larger variations would have to be permitted for shafts with a greater number of pins.

A built-up crankshaft would permit the use of a greater number of cylinders per pin, providing such a shaft could be made equivalent to a solid one.

Airscrew weight could be reduced with an increased number of cylinders.

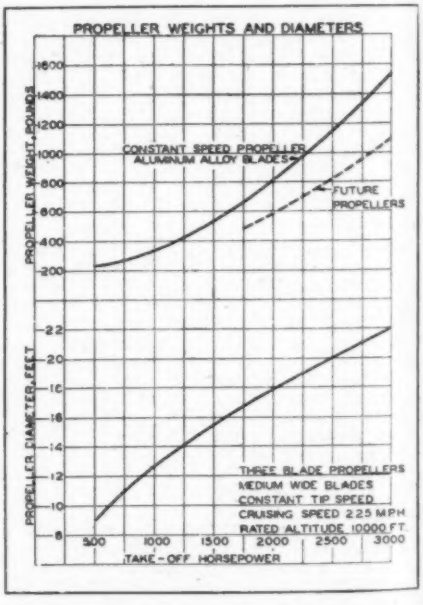
The use of a minimum number of maximum-displacement cylinders gave a comparatively rough-running engine with a shorter life and usually with the maximum frontal area. Radial combinations of at least thirty cylinders appeared feasible.

Greater power might be secured by the combination of two or more engines in a single unit as illustrated by the Fiat AS-6 racing engine and the Napier-Halford Dagger. Both these arrangements furnished a means of utilising a greater number of crank pins and therefore increasing the displacement and consequently the output.

In concluding, Mr. Mead expressed the opinion that the general trend in engine development was toward ever-increasing outputs per litre, with the consequent effect of improving the take-off powers and reducing the engine size in the geometric sense. The development of present standard types tended toward smaller cylinders for the higher outputs. Service consumptions of 0.40 lb./h.p./hr. might be achieved within the next few years.

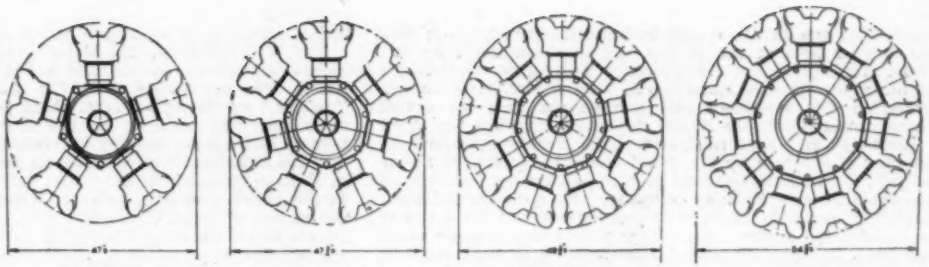
Reductions in power plant drag might well result in cutting the fuel bill by as much as 10 per cent., which, combined with a possible further improvement in specific consumption, gave hope of a net saving of 15 to 20 per cent.

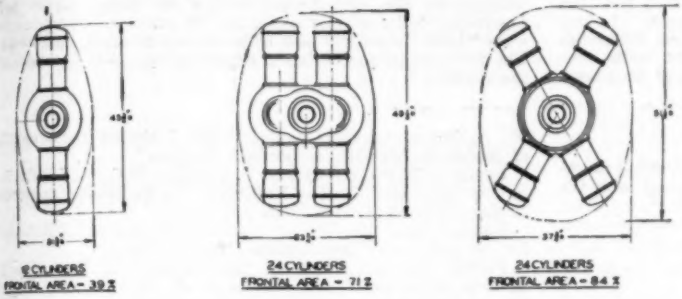
Mr. Mead did not hesitate to affirm that power plant develop-



The airscrew weight-and-diameter problem is becoming increasingly prominent.

While showing the undoubted advantage of in-line engines over radials in respect of frontal area, these diagrams from Mr. Mead's paper do not tell the whole story, which would entail the weighing-up of many mechanical and cooling considerations.





ment could, and would, keep pace with requirements. He wished to draw attention to the debt that American commercial aviation owed to the Army Air Corps and Naval Air Service.

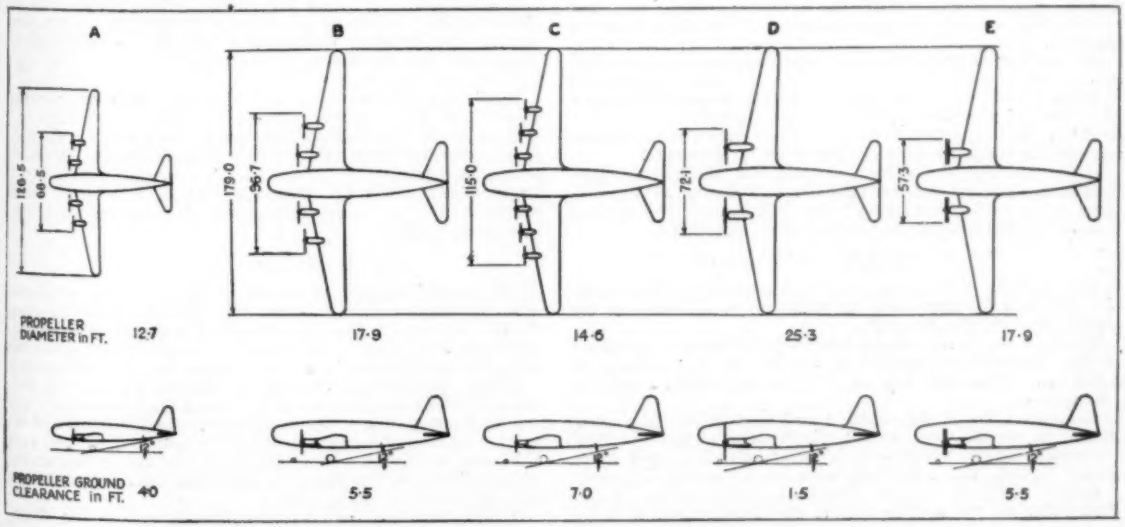
THE DISCUSSION

MR. D. R. PYE, Director of Scientific Research at the Air Ministry, who was in the chair, drew attention to the fact that it had often been suggested that in Great Britain aero engine development had been dominated by military considerations. Mr. Mead was in the unique position of combining the engine designer's and the aircraft operator's points of view, and had confined himself in his paper to civil considerations. Yet if one compared the two it was found that British and American experience and development had been on very similar lines.

He was rather doubtful about the lecturer's advocacy of a multiplicity of smaller parts. Aircraft designers were already contemplating figures like 5,000 h.p. and the mind boggled at the number of bits and pieces that would be needed if a large number of cylinders were to be used.

Mr. A. H. R. FEDDEN expressed the views of the entire audience when he complimented Mr. Mead on a very interesting and informative paper. He had a profound respect for Mr. Mead's ability and recalled that it was now just about ten years since he (Mr. Fedden) paid his first visit to the then newly started works at Hartford, Conn., where he saw the first Pratt and Whitney Wasp. He had kept in close touch with their developments ever since, with great benefit to himself. He would like to know more about ceramic materials in sparking plug construction, and also asked whether Mr. Mead, in referring to better bearing materials, thought an improved lead-bronze or some other material was likely to be the solution. In this country we had obtained good results with cadmium alloys. He was sorry the lecturer had not referred to compression ignition engines, and asked if they had lost interest in America. Also, he was intensely interested in direct petrol injection and asked if work on this was being proceeded with in America. Mr. Mead's figures for airscrew weights tallied with those obtained by the Bristol Company. For high powers he thought a greater number of engines offered a better solution than a smaller number of more powerful engines. He was of the opinion that the aero engine designer was justified in claiming that he could produce cylinders which would develop more power than the airscrew could absorb.

MAJOR G. P. BULMAN, of the Air Ministry, in one of his usual witty speeches, likened Mr. Mead to a friendly adversary at a game of bridge. He (Major Bulman) had been trying to guess what cards Mr. Mead held; in other words, what sort of Pratt and Whitney engines we were likely to see during the next five years. He, personally, felt that development in America and Great Britain would go hand in hand. The small-cylinder advocates in this country would be grateful to Mr. Mead for his support of their views. It might interest Mr. Mead to



Some design problems of the immediate future are revealed in this unusually interesting set of diagrams.

know that one British engine had already completed its 100-hours type tests at the 47 h.p. per litre mentioned by Mr. Mead as a likely future development. This figure was obtained at an engine speed of 4,000 r.p.m. (Later Mr. W. P. Savage corrected this statement and pointed out that the actual figure obtained with the Napier engine was 49.7 h.p. per litre.)

MAJOR F. M. GREEN recalled that the fourteen-cylinder two-row radial favoured by Mr. Mead was actually started at the Royal Aircraft Establishment in 1916 and was later developed by the Armstrong Siddeley company. He questioned the lecturer's reference to an airscrew position one-half the diameter in front of the engine. With large powers and large-diameter airscrews this position would necessitate an airscrew shaft of considerable weight. He asked whether they had experimented in America with spring drives and hinged airscrew blades, as there was a little evidence in this country that by these means airscrew weight could be reduced.

MR. RODNEY BANKS wanted information about how the Americans managed to rate fuels up to 100 octane. In this country we had not been able to do so. He foresaw difficulties in reproducing ground-level powers at great height with 100-octane fuels. He was also interested in results of tests with turbo-blowers at great heights which might have been made.

MR. W. S. FARREN, like Major Green, was puzzled by the lecturer's reference to the half-diameter position of the airscrew. He understood that the N.A.C.A. almost had a "patent" on the 25 per cent. chord position. He would like more information about the bi-fuel system (100 octane for take-off and a lower number for cruising). It was remarkable how the Americans had been able to test out a number of ideas on their commercial air lines; this was evidently one of them. In this country we had, perhaps, been a little short-sighted in the matter of metal blades and v.p. airscrews, having looked merely on the aspect of weight and overlooking the advantages which more than balanced the extra weight by enabling a greater pay load to be taken off.

MAJOR B. C. CARTER, of the R.A.E., was interested to know how the Americans measured the one-half degree limits in oscillation. He uttered a warning against placing too much reliance on the two torque curves for nine-cylinder and fourteen-cylinder engines shown by the lecturer. These curves were "ideal" ones and bore little relation to actual conditions. The peaks of torque variation depended upon the dynamics of the system.

Brook at it Again

MR. H. L. BROOK left Gravesend at 5.22 on Sunday morning in a Percival Gull (D.H. Gipsy Six engine) with the intention of breaking Miss Amy Johnson's record of 3 days 6 hr. 26 min. for a flight to the Cape. On reaching Khartoum at 9.27 a.m. (B.S.T.) on Monday, after covering nearly 3,500 miles, he complained of fatigue, but pushed on for Juba at 10.7 a.m.

During the day he was reported missing, but it transpired that he had been forced down 100 miles north of Juba by a thunderstorm.

He reached Juba safely at 7.15 a.m. on Tuesday, but broke his tail wheel in taking off for Kisumu, and stopped for repairs.

As *Flight* went to press on Tuesday Mr. Brook was reported to be 24 hours behind his schedule.

The Cape in 29 Hours?

ANOTHER attempt, that brings into view the possibility of a London-Cape flight in one day, was due to start from Hatfield at 5 a.m. yesterday.

Flying a Caudron Typhon with two supercharged Renault engines, Prince Cantacouzene, the Roumanian pilot, planned to reach Cape Town in 29 hours by the West Coast route, making two stops *en route*, and then to turn north-east and makes Johannesburg in another four hours.

The distance is somewhere round 6,500 miles, and on the face of it, the Prince's intentions seem startling, to say the least. But it must be remembered that his two Renault engines are specially supercharged for 6,000 metres, and he intends to make the flight at 6,000-7,000 metres, cruising at 220 m.p.h., when he will have an economic range of 8,000 metres (5,000 miles). With the favourable winds expected at this high altitude the practicability of his plans becomes manifest.

His machine is most completely equipped, and has radio and an automatic pilot. Prince Cantacouzene has even planned to allow himself to doze in safety. An alarm system sounds a klaxon if the machine departs from its course or starts a dive or climb; if that fails to wake him, he receives a more definite reminder in the form of an electric shock in his wrist!

It was decided, at the last moment, that Hatfield was preferable to Croydon for the take-off, and Surrey Flying Services, who were "mothering" the Prince, had a busy day transferring the 100-octane fuel and other necessities.

R.Ae.S. Medals and Awards

THE R.Ae.S. Gold Medal has been awarded posthumously to the late Señor Juan de la Cierva for his work on the development of the Autogiro.

This was one of the annual awards made during the evening of Mr. Wimperis's presidential address to the society on April 26. The full list of medals and awards was as follows:—

Society's Gold Medal.—The late Señor J. de la Cierva, F.R.Ae.S., for his work on the development of the Autogiro.

Society's Silver Medals.—F. W. Meredith, B.A. and P. A. Cooke, O.B.E., M.C., for their work on the automatic pilot.

British Gold Medal for Aeronautics.—A. Gouge, B.Sc., F.R.Ae.S., for his achievement in the development of flying boats.

Simms Gold Medals.—Dr. H. Gough, M.B.E., F.R.S., and W. A. Wood, for their paper, "New Light on the Strength of Materials Afforded by Modern Physics."

Taylor Gold Medal.—Dr. G. P. Douglas, M.C., A.F.R.Ae.S., for his paper on "Cooling Problems with Particular Reference to the Work of the 24ft. R.A.E. Tunnel."

Edward Busk Memorial Prize.—G. H. Dowty, F.R.Ae.S., for his paper on "Retractable Undercarriages."

Pilcher Memorial Prize.—H. Leaderman, B.A., B.Sc.(Eng.), for his paper on "The Fundamentals of Boundary Layer Theory with Some Applications to Aircraft."

Another Handicap

IT seems but a few months since *Flight* expressed its pleasure at being able to announce that, after a lengthy separation, those two famous handicappers Messrs. Rowarth and Dancy had been re-united at Martlesham, where both had been given appointments. There is, however, no peace for anyone, be he wicked or righteous, in D.T.D.'s department, and service considerations must necessarily come first. Capt. Wilfred Dancy has been appointed Resident Technical Officer at Supermarine's Woolston works, and took over a short time ago. Mr. S. Scott-Hall has been transferred to Orfordness. One need not, however, fear that handicapping in this summer's air races will suffer, as Rowarth and Dancy have previously proved their ability, at considerable inconvenience to themselves, to work together even when stationed in different parts of the country.

Rossi's New Record

IN the Caudron Typhon (two 220 h.p. Renaults with Ratier airscrews) illustrated in *Flight* last week, Captain Rossi established last Saturday a new speed record of 311 km./hr. (194.37 m.p.h.) for 5,000 kilometres (3,125 miles) over a closed circuit. He thus surpassed by about 40 km./hr. (25 m.p.h.) the existing record made by the American pilots Tomlinson and Bartles in a Douglas D.C.2 (two 710 h.p. Cyclones) in May, 1935.

Rossi took off from Istres aerodrome at 5.15 a.m., carrying 2,400 litres (533 imperial gallons) of fuel and 120 litres (27 gallons) of oil. The machine thus weighed 4,350 kg. (9,570 lb.). Rossi traversed the circuit Istres-Toulouse-Bordeaux-Toulouse-Bordeaux twice, and then turned on to the course Istres-Lyons-Istres, which he covered six times, landing at Istres after 16h. 4m. 3s. Rossi had as his sole companion a Sperry automatic pilot.

For Hush-hush Hangars?

AN unusual method of mounting sliding doors, developed by Silent Gliding Doors, 53, Archer Street, London, N.W.1, has as its chief recommendation silence in operation. Although this aspect is not usually of great importance in the case of aircraft hangar doors, the system has other advantages.

Briefly, the silence is secured by running the doors on ball-bearing wheels over a grooved hardwood track in a steel channel, and interposing a rubber strip between the wheel and the track. The wheel has a central rim with a flange on each side, and, as it moves along the track, the flanges bear on the rubber, while the rim depresses the rubber into the groove sufficiently far to act as a guide.

The system has been successfully adapted to big sliding doors in factories and film studio sound stages, and the makers are willing to co-operate in the design of hangar doors.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters intended for publication in these columns.

A PEERLESS PAIR: On the left is the Breda 88 fighter-bomber in which, as reported in recent issues of *Flight*, the Italian pilot Furio Niclot gained for his country the speed records over 100 km. and 1,000 km., his average speeds being 321 and 295-odd m.p.h. The flying boat is the Cant. Z.508 which carried ten tons to 4,863 metres.

BOTH ENDS OF THE BEAM

I HAVE read with much interest the suggestion made by "McScotch" in your issue of April 22 (p. 398) for improving the recruitment of personnel for the searchlight battalions.

May I ask your contributor to imagine for a moment that he is a potential recruit whose waking hours, and perhaps dreaming hours, have been taken up by flights of imagination at dizzy heights and at wonderful speeds, creating havoc against enormous odds; and who has then experienced the anti-climax of being told, "No, you can't do that, but we have some old searchlights you can play with."

No, Mr. McScotch, we don't want the R.A.F. recruiting rate brought down to the level of the A.A. figures. What we want is the entire anti-aircraft units, guns and searchlights, taken over by the R.A.F. and these reformed into a smaller number of up-to-strength units of the Auxiliary Air Force, and new regular units made up of the older men from the flying branch of the Service.

How many times have we all heard the complaint that the R.A.F. offers no career for either officer or man because so few are allowed to serve long enough to qualify for a pension? The fellow who has been in the flying branch for, say, ten to twelve years is the ideal man for the A.A. units. He will know both ends of the searchlight beam, so to speak, and will be very content to have an interesting ground job at which to finish his time.

The flying branch of the R.A.F., with a few exceptions, staff, administrative, etc., is a young man's job. Give the A.A. to the Air Ministry so that they can make a job of it and play fair with their men at the same time. McCOCKNEY.

London, S.W.19.

REVIVING THE COASTAL AIRSHIP

I WAS glad to see Mr. W. O. Manning's article, "Blimp Redivivus," in the April 22 issue of *Flight*.

As long as our existence depends on food supplies from abroad our defence system cannot be considered complete until it includes anti-submarine airship patrols. Your readers may therefore be interested in the following letter of mine which appeared in *The Spectator* on April 17, 1936:—

"The subject of defence is receiving a great deal of attention just now, and it is generally admitted that one of our biggest problems is that of safeguarding the ships which bring food to this country. The air menace seems to be causing the greatest interest, but it should not be forgotten that the enemies' submarine campaign came very near to defeating us in the last war.

"Few people seem to realise that it was our small scouting airships (in co-operation with surface craft) which enabled us to defeat the submarine and save the country from what had become an almost mathematical certainty of starvation. Owing to the extreme urgency of the case the airships and their crews were put into service with the absolute minimum of trials and training, but in spite of this they proved their value—and saved our bacon.

"For convoy and anti-submarine patrols the small airship has many advantages over the heavier-than-air craft. It is cheap to build and operate; it has far greater endurance (24 hours is well within its capabilities); it can keep station with a convoy, or remain over one particular spot if required. Crews and fuel can be transferred from a ship to the airship, and in an emergency the airship can be towed.

"For the cost of one light cruiser we could build a small fleet of these coast patrol airships and train our men in the ways of lighter-than-air craft. Some of our smaller warships could then be released from scouting in home waters for patrol on our trade routes far from land.

"There is no doubt that, as long as the submarine exists, the small scouting airship has a definite place in our scheme of defence. The Government has made up its mind to put our defences in order, and now is the time to show that we have not forgotten one of the lessons which we learnt, only just in time, in the last war."

Not only would these airships be important from the point of view of defence, but they would also provide us with men experienced in the operation of lighter-than-air craft, who will be very useful when we come to realise that for passenger-carrying over long-distance ocean routes the airship has many advantages over the aeroplane or flying boat.

Walton-on-Thames. E. N. B. BENTLEY, A.F.R.Ae.S.

"ULTRA-LIGHT" TRIALS AGAIN

DURING the past few months there have appeared a great many new ultra-light types of aircraft, and, as has been said before, some are good but many are very bad. The chief trouble, as far as I can see, is the fact that in many cases the effort to get that extra 5 m.p.h. cruising speed sacrifices what, in my opinion at any rate, is the first essential of any aeroplane to be flown by an amateur pilot—namely, a quick take-off and a good climb for the first 1,000ft. or so.

The attempt to produce the ultra-light in the present form, the low-wing cantilever monoplane cleaned-up for extra speed on a mere 45 h.p. or so, would far better be replaced by a small biplane something like that which, with a 50 h.p. Green engine, the late Bert Hinkler flew to Tunis. Even if you do lose a small amount of speed the better take-off and climb should justify it.

It would be an excellent idea if an ultra-light trial were organised, preferably international, points being awarded for the finest characteristics, namely, take-off, climb, landing speed, stalling speed, and lastly, top speed. Any entrants who failed to obtain a certain minimum of points should be finally stopped, and if this were firmly done the survivors would be fairly safe and good. P. FLETCHER.

London, W.2.

MERITORIOUS

I WOULD like to take this opportunity of recording what I consider to be, in its way, a very interesting flight.

I am the owner of one of the earlier Monospar S.T.4s fitted with Pobjoy "R" engines. Without any special preparation, and at very short notice, a friend of mine, Mr. C. G. M. Alington, flew it out to Cairo, to take part in the Oases Rally. Unfortunately, owing to a hitch over the insurance, the veteran Monospar was not able to show its mettle in the race, as it had to be scratched.

Mr. Alington decided to stay out in Egypt, so a friend of his, Mr. Willows, agreed to fly it back to England. After only a few circuits to get the feel of the machine, and with no other experience of twin-engined aircraft, Mr. Willows flew straight back to England.

No records were attempted, but I do think this casual flight is a remarkable testimony to the flying qualities of this elderly machine and to its engines. S. E. EDWARDS.

Folkestone, Kent.

THE FOUR WINDS

ITEMS OF INTEREST FROM ALL QUARTERS

ARRANGEMENTS are being made for the observation of May 29 as Empire Air Day throughout Australia.

Woodstock Mill, Royton Junction, near Manchester, has been bought by the Air Ministry for the manufacture of aircraft parts.

Struck by lightning, an observation balloon crashed from 2,000ft. over Mailly Camp, in France. One occupant was burned to death.

The Argentine Ministry for War has placed contracts for the supply of 110 machines for the Argentine Army. Twenty will be constructed in Germany and ninety in the U.S.A.

Among the aircraft which will be demonstrated at the R.Ae.S. Garden Party at Heathrow (a preliminary list of which appeared in *Flight* of April 15) will be the Hafner gyroplane; this will be its first public appearance.

The Airspeed Envoy built for the use of the Royal Family is understood to accommodate four passengers, steward and wireless operator in addition to Wing Commander E. H. Fielden, the pilot. It has Siddeley Cheetah engines and the interior is said to be finished in grey and red.

The Federation of British Industries, in reply to a Home Office request that manufacturers should co-operate in air-raid precaution schemes for their factories, suggests that the Government should bear the cost, especially since the factories would mostly be on national service in time of war.

The Siamese Government has ordered a number of Martin, twin-engined bombers, the value of the contract being 625,000 dollars.

A new glider-looping world record is said to have been established by Flt./Lt. E. L. Mole, who, at Cairo recently, looped 67 times in succession.

M. Pierre Cot, the French Air Minister, was due to fly to London yesterday to be chief speaker at a peace rally at the Albert Hall and to meet Mr. Winston Churchill and other M.P.s.

The S.B.A.C. static exhibition will be held in the R.A.F. Reserve hangar at Hatfield on Monday, June 28, and Tuesday, June 29. Aircraft will be available for inspection on the Monday, and will be demonstrated on the Tuesday.

One hundred men from the R.A.F. depot at Uxbridge, with the assistance of the Royal Air Force Band of 60 players, will give a display including figure forming, club swinging, doubling and singing, at the Royal Tournament to be held at Olympia from May 27 to June 12. No member of the display party was in the Service before January this year.

In view of the fact that low flying is liable to be a source of danger to racing drivers, pilots may not land on Brooklands aerodrome between 1300 and 1730 hours on May 1 and 17, June 26, July 10, August 2, September 18 and October 16, without first having obtained written permission from the aerodrome manager. Pilots should also avoid flying near the track below 2,000 feet during races.

GEOGRAPHY AND GEODETICS: Vickers aircraft (on the marine side, at all events) are well known to men of the Royal Australian Air Force, so it was with keen interest that this Coronation contingent inspected the Weybridge works last week. They are seen in front of a Wellesley. (*Flight* photograph.)

RECORD-WRECKER: The French pilot Rossi, who, as related on page 418, broke the speed record over 5,000 km. in a Renault-engined Caudron Typhon last week.

In view of the fact that a "tricycle" landing gear is specified for the Douglas D.C.4, it is interesting to learn that an undercarriage of this type is being tested on an OA4-B amphibian by the U.S. Army.

The Emperor of Japan has conferred the "Order of the Rising Sun" on the pilot (Mr. Iinuma) and the wiress operator (Mr. Tsukagoshi) of *Divine-Wind*.

The third "routine transfer" of aircraft from the U.S.A. to Honolulu was completed recently when twelve of the new Consolidated PBY-1 flying boats (two Twin Wasps), manned by crews totalling eighty, made the long trip non-stop.

Herr Hitler has issued a decree for the creation of a Nazi flying corps with the objects of "Keeping alive the aviation spirit in the German people, establishing a system of preparatory flying instruction prior to military service and unifying the manifold air-sport activities of Germany."

Twenty-five Years Ago

(From "Flight" of April 27, 1912.)

"Summer is approaching, and it would be a thoroughly fine thing for aviation generally if a few enterprising financiers were to place immediate orders for a small fleet of hydro-aeroplanes, cum pilots, with which they could establish themselves at the principal seaside resorts in the height of the season for the purpose of giving passenger flights on a calm day."

April 29, 1937.

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THE WELDING of ALUMINIUM

Some Notes on the Oxy-Acetylene Process and the Choice of Welding Rods

By N. F. DANIEL, B.Sc., A.I.C.*

THE use of aluminium and aluminium alloys has grown to an enormous extent during recent years. There are few industries where aluminium does not find a place, and in the aircraft industry in particular are the properties of aluminium and aluminium alloys exploited to the full.

Perfectly pure aluminium is rarely, if ever, used. It is possessed of many useful and important properties, but there are two reasons why it is not used to a large extent industrially. In the first place, the cost of producing the perfectly pure product would be prohibitive, and in the second place the properties of the pure metal are very readily improved by alloying with a certain number of other metallic elements.

There are many aluminium alloys on the market to-day, each alloy having properties intended for specific purposes and involving its own particular problems of production and manipulation. In this article we are concerned with the welding of aluminium and aluminium alloys by the oxy-acetylene blowpipe flame. It will not, perhaps, be out of place to indicate the reasons for alloying aluminium and hence the need for aluminium alloy welding rods.

Although, as has been said, perfectly pure aluminium is not much used, yet there is a very wide field for commercially pure aluminium, particularly in the form of sheet. In the cast condition pure aluminium does not possess very good mechanical properties, since it is easily corroded, is hot-short and is subject to considerable shrinkage on casting. To off-set these disadvantages it should be remembered, however, that aluminium is one of the lightest metals known, it has high thermal and electrical conductivity, is extremely ductile and malleable, and, what is more important, it is readily weldable.

The reason for alloying is, then, to combine the low specific gravity, high thermal and electrical conductivity, great ductility and malleability of the aluminium with the high tensile strength, hardness, and machineability of other commonly occurring metals. It is a fortunate fact that aluminium lends itself to this process of alloying, and the resultant alloys constitute some of the most useful materials known to-day. The process of alloying is often accompanied by a suitable process of heat treatment, and the properties of the heat-treated alloy compared with the untreated cast aluminium are sometimes extraordinary.

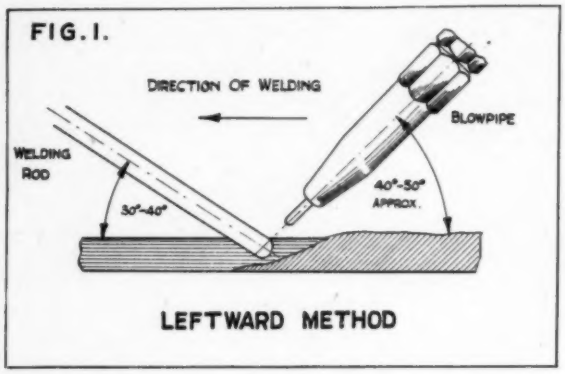
Preparation for Welding

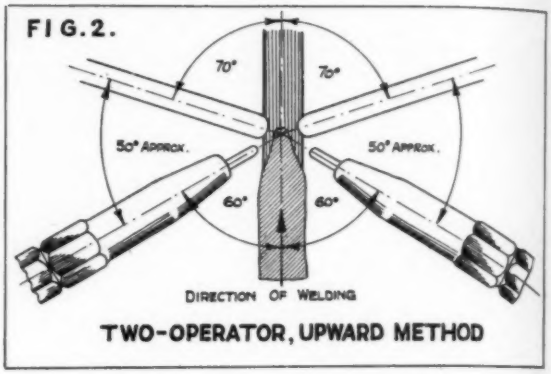
The greatest enemies to successful aluminium welding are oil and grease, and since the majority of castings are usually contaminated with these substances, the following procedure should be adopted wherever possible. The casting to be welded should be given a preliminary washing in petrol, followed by a 10 per cent. solution of caustic soda, then by a 10 per cent. solution of nitric or sulphuric acid in order to remove any trace of alkali, and finally the metal should be rinsed with hot water. It is not always possible, however, to carry out such a thorough cleaning procedure, and when such is the case the edges should be made as clean and bright as possible by sharply brushing with a wire brush. In the case of sheet aluminium it is usually quite sufficient to clean up the edges with a wire brush, file or abrasive stone.

Preparation of the edges when welding sheet aluminium is similar to the preparation adopted for other non-ferrous metals. Thin sheet aluminium, for example, 16 g. or less, should be flanged to a depth equal to twice the thickness of the sheet, if this may conveniently be done. Sheet aluminium of 16 gauge to ⅛in. thickness should be butt-welded without bevelling, whilst for greater thicknesses bevelling to an included angle of 90° should be adopted. Where convenient, the method employing two welders working simultaneously from opposite sides of the plate and welding in a vertical plane can be strongly recommended. This method is known as the two-operator vertical method and is described later.

The procedure known as notching is often useful, and

* Mr. Daniel is on the staff of the British Oxygen Co., Ltd.





may be described briefly as follows: The edges are first saw-cut inward to a depth about equal to the thickness of the material, the saw cuts being about twice the thickness of the material apart. This type of preparation, of course, applies particularly when unbevelled edges are butted close together, and undoubtedly assists in the penetration of the weld and activity of the flux. Notching is also useful when it is necessary to join on bevelled edge and unbevelled edge, the notching being applied to the unbevelled edge. Also, if the bottom edges of bevels are close butted for some reason or other, or the edges are not bevelled for their full thickness, notching is again useful in securing adequate penetration.

To get the best results when welding aluminium it is necessary to use a suitable flux. The purpose of the flux, of course, is to remove the refractory oxide of aluminium, alumina, and to enable a good clean joint to be made free from inclusions. The flux must fulfil a number of requirements; it must, in the first place, be capable of dissolving the aluminium oxide and melt at about 100°-150° C. below the m.p. of the alloy being welded. In the fused state it must have a specific gravity less than the molten alloy so that it may float on the surface of the metal, and it must have the correct degree of viscosity. Not only must the the flux contain the correct constituents necessary to give it the properties outlined, but they must be in the correct proportions and properly mixed, hence it is advisable to use only fluxes of guaranteed efficiency, manufactured by experts.

The flux may be applied either as a powder or a paste, but it should always be used sparingly both for reasons of economy and efficiency.

Method of Welding

As far as single-operator underhand welding on sheet up to $\frac{3}{16}$in. or $\frac{1}{4}$in. is concerned, the best technique is the leftward or forward method.

The arrangement of the rod and the blowpipe is that shown in the sketch (Fig. 1). When the sheet thickness exceeds $\frac{1}{4}$in. the two-operator vertical method should be adopted wherever possible, and the corresponding arrangement of blowpipes and welding rods is that shown (Fig. 2).

A neutral flame should be used, and care should be taken to see that the acetylene is quite free from impurities. Dissolved acetylene will be found the most suitable fuel gas.

When welding aluminium an acceleration of welding speed takes place during welding, due to the rapid rise in temperature of the metal surrounding the edges consequent on the high thermal conductivity of aluminium, and this is apt to give a certain amount of trouble to the beginner. Once the essentials have been mastered, however, it is possible to make excellent welds in aluminium, and to render them quite invisible after suitable dressing and polishing.

In the case of aluminium welding, finishing off the weld is just as important as the welding itself. The first matter to which attention should be paid is the removal of flux. The fluxes used for aluminium welding are strongly corrosive in action, and every trace of flux must be removed on completion of the weld. A good method is to wash in warm water and then to brush vigorously with a metal brush. Wherever possible the welded article should be dipped in a warm 5 per cent. solution of nitric acid and immediately rinsed in warm water. It is sometimes recommended that a second washing be carried out after a few days in order to make certain that the last trace of flux has been removed.

The second important point connected with finishing off the weld is the improvement in properties brought about by heat treatment and mechanical work on the metal. As deposited the aluminium has a cast structure and is rather coarse grained. This may be seen in the micrograph (Fig. 3). On blowpipe annealing and hammering, however, the metal undergoes considerable refinement of grain

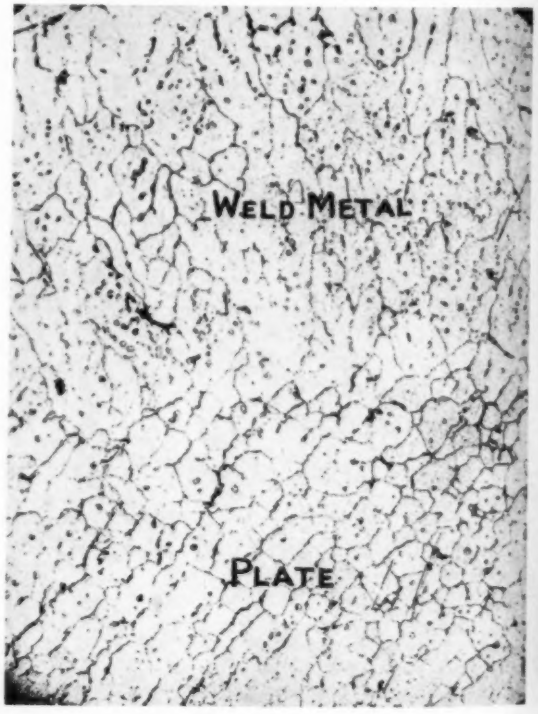
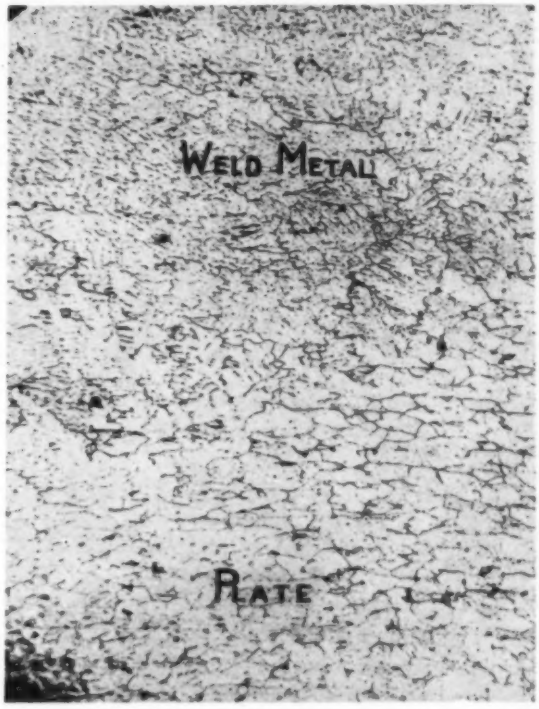


Fig. 3.—Aluminium weld, as welded.

Fig. 4 (Right).—Aluminium weld, cold-hammered and blowpipe-annealed.



and the mechanical properties are rendered equal to or better than the unwelded sheet. The structure of a hammered and annealed weld in aluminium is shown in Fig. 4, and the improvement is very evident.

Not only does hammering cause a refinement in structure, but it also helps to relieve contractional stresses, to remove surface porosity and to consolidate the surface of the weld.

The choice of a welding rod depends, of course, upon the nature of the material being welded and the class of work. There are three main classes of rods in general use —pure aluminium, silicon-aluminium and copper-aluminium. We shall proceed to give a few notes on the nature, properties and uses of these three welding rods.

Welding Rods

Pure Aluminium Welding Wire.—This rod is composed of commercially pure aluminium. It contains about 99.5 per cent. or more pure aluminium, the remainder being small amounts of silicon, iron, etc. The mechanical properties of an all-weld-metal specimen deposited by the oxy-acetylene flame are as follows, the microstructure of such a specimen being that shown by the micrograph (Fig. 5).

Yield stress	1.6 Tons/sq. in.
Ultimate stress ..	4.1 Tons/sq. in.
Elongation	38.0% in 2in.
Brinell Hardness ..	13.7
Izod Impact Value ..	12.8 ft./lb.

This rod is widely used for the welding of sheet aluminium for petrol tanks, oil tanks, foodstuff containers, chemical plant and aluminium vessels of all kinds and descriptions. The pure aluminium welding wire should always be used for the welding of aluminium articles which are subsequently submitted to "anodic" treatment.

Fig. 5.—Pure aluminium welding wire.

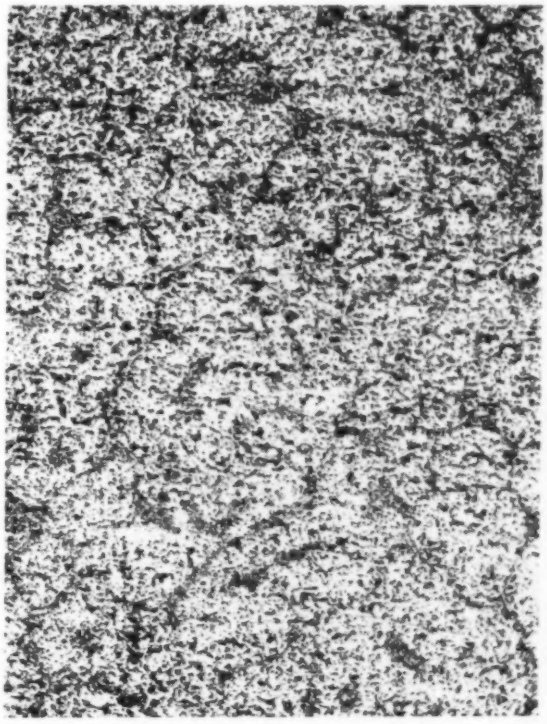


Fig. 6.—Five per cent. silicon-aluminium. This welding wire should be used when a rod having a slightly lower melting point than pure aluminium is required. The deposit has greater tensile strength and hardness than pure aluminium.

Silicon-Aluminium Wire

It has been found that the addition of silicon to aluminium results in many useful features. Since silicon is a lighter element than aluminium the addition of silicon causes a decrease in the specific gravity, which is of extreme importance in those industries in which lightness is an essential feature. The addition of silicon to aluminium causes the disappearance of hot-shortness, shrinkage is decreased and the melting-point of the metal is reduced. The effect of adding silicon to aluminium is to reduce the melting point of aluminium progressively until a minimum melting point of about 575° C. is reached in the neighbourhood of 12 to 13 per cent. silicon.

The tensile strength and the hardness of the material are increased by the addition of silicon. There are two general types of silicon-aluminium welding wire, the 5 per cent. silicon and the 10 per cent. silicon, and we may consider the properties of each in turn.

5 per cent. Silicon-Aluminium Alloy Welding Wire.—This is a drawn rod consisting of about 95 per cent. aluminium and 5 per cent. silicon. There are also small amounts of iron, copper, zinc, etc.

When deposited by the oxy-acetylene blowpipe flame the structure shown in the micrograph (Fig. 6) is obtained.

The mechanical properties of the metal when deposited without any subsequent heat treatment are as follows:—

Yield stress ..	.. 3.7 Tons/sq. in.
Ultimate stress	.. 7.4 Tons/sq. in.
Elongation ..	.. 7% in 2in.
Brinell hardness	.. 37.6
Izod impact value	.. 2.7 ft. lb.

10 per cent. Silicon-Aluminium Welding Wire.—This material contains about 10 to 12 per cent. silicon, and naturally it is considerably lighter than pure aluminium.

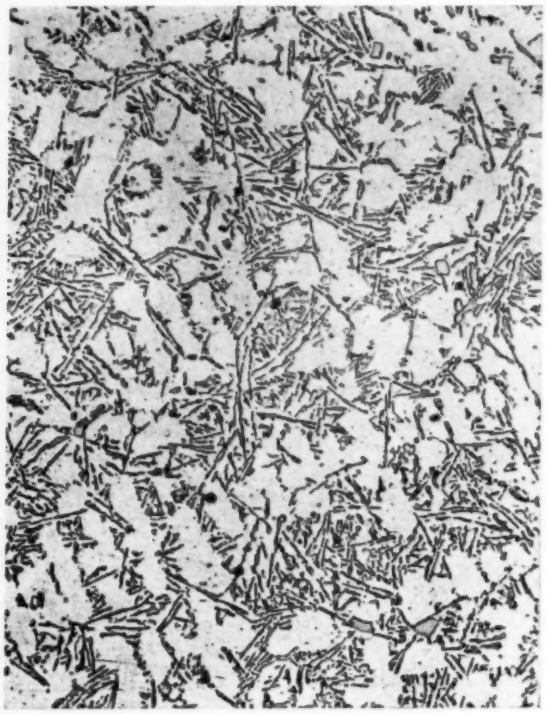


Fig. 7.—Ten per cent. silicon aluminium. The use of this rod is almost entirely confined to castings, particularly those of the Alpax type. The rod has a melting point 60-70 deg. lower than that of pure aluminium.

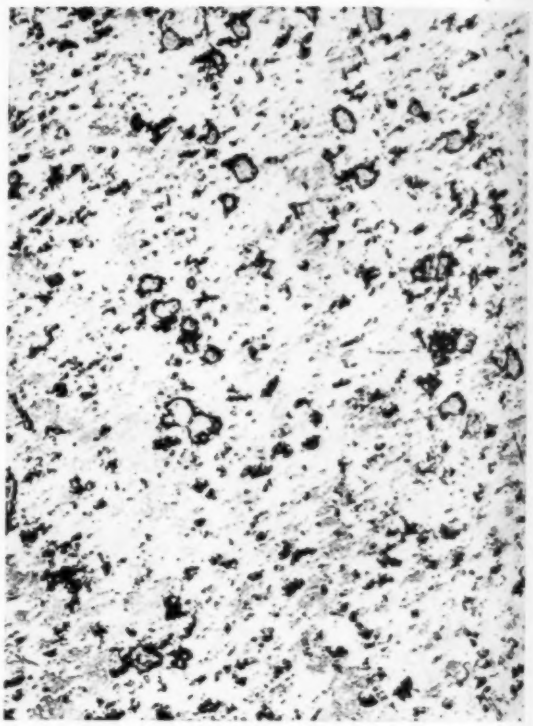


Fig. 8.—Five per cent. copper aluminium. This rod is used for welding castings which have a composition that includes approximately five per cent. copper. The rod gives a deposit which is harder than that of the other aluminium alloy welding wires described.

If the specific gravity of pure aluminium is taken as 2.70, that of the alloy would be only about 2.65. The melting point is considerably lower than pure aluminium, which is an extremely useful property in many cases. When deposited by the oxy-acetylene blowpipe the structure of the material is as shown in Fig. 7.

The mechanical properties of the deposited metal are as follows:—

Yield stress ..	.. 5.7 Tons/sq. in.
Ultimate stress	.. 8.9 Tons/sq. in.
Elongation ..	.. 6% in 2in.
Brinell hardness	.. 46.8
Izod impact value	.. 1.6 ft. lb.

Copper-Aluminium Wire

5 per cent. Copper-Aluminium Alloy Welding Wire.—Copper-aluminium alloys have been used in industry for a long time for such purposes as domestic utensils, automobile parts, etc., and they have many desirable properties. They have good tensile strength, ductility and quite a low specific gravity.

The rod suitable for the welding of copper and aluminium alloys is known as the 5 per cent. copper-aluminium alloy. The rod consists of 95 per cent. aluminium and 5 per cent. copper and must not contain more than 0.5 per cent. of impurities.

The structure of the deposited material is shown in the micrograph (Fig. 8), and such a deposit gave the following figures for the mechanical properties:—

Yield stress ..	.. 5.8 Tons/sq. in.
Ultimate stress	.. 6.2 Tons/sq. in.
Elongation ..	.. 1 % in 2in.
Brinell hardness	.. 80.0
Izod impact value	.. 1.2 ft. lb.

LONGITUDINAL STABILITY

An Investigation with Particular Reference to Low-wing Monoplanes

By W. R. ANDREWS, A.F.R.Ae.S.

(*Continued from page 19.*)

Loading of Biplane Wings

(*a*) *Equal-wing Biplane—no Decalage.*

IT has been customary to use a single curve (Reference 4) giving the ratio of lift on the upper to that of the lower plane for any biplane. This ratio has been expressed in terms of the angle of stagger of the wings. Diehl (References 5 and 6) has shown that a semi-rational method is possible, using the aspect ratio, gap and stagger from no-lift as parameters. The method is developed for any wing arrangement. For an equal-wing biplane a possibly simpler expression is obtainable.

Using Diehl's data and references he gives Munk's expressions for the additional lift coefficient of staggered wings as

$$K_L = \pm 2K_L \frac{S}{b^2}\left(\frac{1}{k^2} - .5\right)\frac{b}{R}\cdot\frac{s}{C}\cdot\frac{C}{b}$$

where b = span
S = area
s = stagger with respect to the no-lift line
k = equivalent monoplane span factor
R = a distance used in calculating induced downwash.

This can be re-written as follows

$$\frac{\triangle K_L}{K_L} = \pm 2\frac{s}{R}\left(\frac{1}{A} - \frac{.5}{A_m}\right)$$

where $A = \frac{k^2b^2}{S}$ = equivalent monoplane aspect ratio of the wing arrangement

A_m = monoplane aspect ratio of each wing separately.

This relationship can be easily expressed in terms of known quantities obtainable from wind tunnel data, and the equivalent monoplane aspect ratio thus

$$\frac{\triangle K_L}{K_L\left(\frac{1}{A} - \frac{.5}{A_m}\right)} = \frac{c}{g}f(\phi)$$

on the assumption that R is a function of c/g and (ϕ), where ϕ_1 = angle of stagger to no-lift, and g = gap.

This is done in the following table, where, from test results, $A_m = 6$ and $.5/A_m = .09$ in each case.

These results are plotted in Fig. 3. It will be noticed that the grouping of the points is quite equal to that of Fig. 13 of Diehl's report (Reference 5).

The points of Fig. 3 actually fall into three main groups, each represented approximately by a straight line. The figures of Table II of Diehl's report follow the approximate relationship

$$\frac{\triangle K_L}{K_L} = \theta = (.29 + .0228\phi_1)\frac{C}{g}\left(\frac{1}{A} - \frac{.5}{A_m}\right)$$

the values for Diehl's Table III

$$\theta = (.27 + .0186\,\phi_1)\frac{C}{g}\left(\frac{1}{A} - \frac{.5}{A_m}\right)$$

and the third from the value of Table IV

$$\theta = (.2 + .0186\,\phi)\frac{C}{g}\left(\frac{1}{A} - \frac{.5}{A_m}\right)$$

Tables II and IV represent direct force measurements in American and British wind tunnels respectively and

Stagger ϕ_1 Degrees.	K	A	$\left(\frac{1}{A} - .09\right)$	$\frac{K}{\left(\frac{1}{A} - .09\right)} = B$	$\frac{s}{C}$	$\frac{Bg}{c} = f(\phi)$
			TABLE II—DATA.			
−25.2	−.104	3.84	.17	− .61	.9	− .55
−36.5	−.104	4.04	.158	− .66	1.2	− .792
1.2	.127	3.63	.186	.683	.6	.41
1.2	.088	3.77	.175	.502	.8	.402
1.8	.06	3.90	.167	.359	1.0	.359
2.3	.038	4.04	.158	.24	1.2	.288
9.7	.157	3.63	.186	.845	.6	.506
14.6	.116	3.84	.170	.682	.9	.614
19.3	.104	4.04	.158	.657	1.2	.788
19.8	.236	3.63	.186	1.27	.6	.761
28.4	.178	3.84	.170	1.048	.9	.943
35.8	.147	4.04	.158	.93	1.2	1.116
−19.3	−.03	3.84	.170	− .177	.9	− .159
9.3	.077	—	—	.45	—	.405
32.6	.198	—	—	1.165	—	1.050
			TABLE III—DATA.			
2.3	.017	3.54	.193	.0881	.5	.044
4.0	.05	3.73	.178	.337	.75	.253
17.2	.111	—	—	.624	.75	.468
29.25	.100	—	—	.90	.75	.675
9.15	.009	3.9	.166	.0542	1.0	.054
5.2	.076	—	—	.458	—	.458
18.8	.096	—	—	.578	—	.578
30.6	.141	—	—	.850	—	.850
40.0	.172	—	—	1.035	—	1.035
6.3	.064	4.06	.157	.408	1.25	.51
19.85	.088	—	—	.561	—	.70
31.35	.096	—	—	.612	—	.765
7.4	.050	4.22	.147	.34	1.5	.51
10.2	.040	4.39	.138	.29	2.0	.58
			TABLE IV—DATA.			
32.1	.130	3.9	.166	.785	1.0	.79
1.1	.027	—	—	.16	—	.16
−28.3	−.115	—	—	− .695	—	− .70
1.1	.036	—	—	.217	—	.22
30.1	.146	—	—	.88	—	.88
16.7	.091	—	—	.55	—	.55
−14.1	0	—	—	0	—	0
3.5	.088	3.67	.162	.543	.667	.362
39.0	.221	—	—	1.365	—	.91

Table III is for pressure distribution tests in the American wind tunnel. Considering the difficulties of this last series of tests, it seems remarkable that such close agreement is obtained.

The full line drawn on the graph represents the mean of the values. This line represents the relationship

$$f(\phi) = (.25 + .020\phi_1)$$

so that finally

$$\theta = (.25 + .020\phi_1)\frac{C}{g}\left(\frac{1}{A} - \frac{.5}{A_m}\right) \quad .. \quad .. \quad (12)$$

and $m = \frac{K_L \text{ upper}}{K_L \text{ lower}} = \frac{1+\theta}{1-\theta}$

Diehl shows that the top and bottom wings do not come to their no-lift angles simultaneously due to a venturi effect between the bottom surface of the top and the top surface of the bottom wing. This might be likened to an equivalent change in the aerodynamic decalage and is neglected for the purpose of the present investigation.

(*b*) *Unequal Wings and Wings with Decalage.*

No attempt has been made to simplify Diehl's method of dealing with unequal wings and wings with decalage and reference should be made to his work except for all but equal-wing biplanes. Diehl's treatment is probably as simple as such a complicated problem allows.

Downwash at the Tail Plane

The downwash at any point behind a monoplane wing is given by the late Mr. H. Glauert as

$$\frac{4\pi w^1}{K} = \frac{x}{x^2+y^2}\left(\frac{s_1+y}{\sqrt{(s_1+y)^2+x^2+z^2}}+\frac{s_1-y}{\sqrt{(s_1-y)^2+x^2+z^2}}\right) + \frac{s_1+y}{(s_1+y)^2+z^2}\left(1+\frac{x}{\sqrt{(s_1+y)^2+x^2+z^2}}\right) + \frac{s_1-y}{(s_1-y)^2+z^2}\left(1+\frac{x}{\sqrt{(s_1-y)^2+x^2+z^2}}\right)$$

where w^1 = downward component of velocity at considered point (see later for suggested reference datum)

x = distance behind wing—feet.

z = distance to starboard—feet.

s_1 = distance from centre line of aircraft to centre of wing tip vortex—feet.

$$K = \frac{S_w}{2s_1} K_L V \text{ where } S_w = \text{wing area—sq. ft.}$$

Glauert stated that since this formula is developed on the conception of a lifting line, some difficulty was experienced in fixing a reference point on a finite wing, but gave his opinion that the C.P. position should be used.

The special case where $y = 0$ (i.e. the downwash in a plane normal to the wing and through its centre) resolves to

$$\beta = \frac{w^1}{V} = \frac{S_w K_L}{4\pi}\left[\frac{1}{s_1^2+z^2}+\frac{x}{\sqrt{s_1^2+x^2+z^2}}\left(\frac{1}{x^1+z^2}+\frac{1}{s_1^2+z^2}\right)\right]$$

Radians which on substitution for

$$D^2 = x^2 + z^2$$

$$x = D\cos\theta$$

and $z = D\sin\theta$

again resolves to

$$\beta = \frac{K_L}{\left(\frac{s_1}{s}\right)^2 A}\ \psi \text{ degrees}$$

where $\psi = \frac{18.24\,(s_1/D)^2}{\sqrt{\left(\frac{s_1}{D}\right)^2+1}}\left\{\cos\theta - \frac{1}{\cos\theta - \sqrt{\frac{(s_1)^2}{D}+1}}\right\}$

This formula, of course, gives the downwash at any point on the vertical plane in the plane of symmetry of the wing. The particular area of this plane which requires our attention is where the tail plane is likely to be placed. Over this area the downwash can be approximated to very accurately by

$$\beta = \frac{\psi K_L}{57{\cdot}3\,.\,A\,.\,(s_1/s)^2} \text{ Radians}$$

where $\psi = \left(K + B\frac{s_1}{D}\right)$

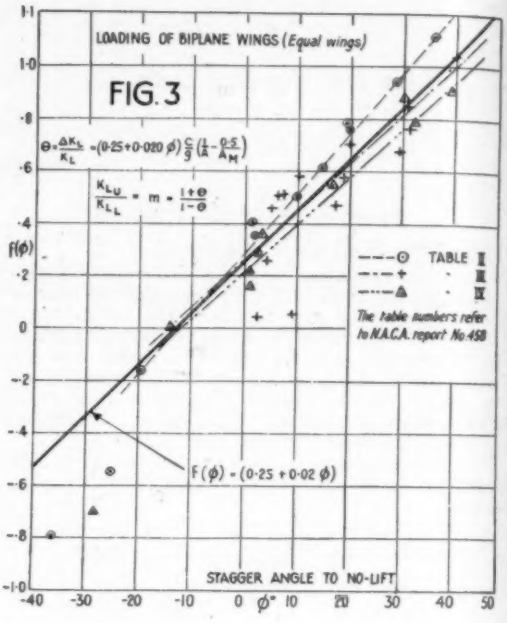
K and B have the following values (see Fig. 4).

θ Degrees.	K	B	θ Degrees.	K	B
0	29·2	14.62	16	24.56	16.31
2	29.12	14.66	18	23.52	16.64
4	28.9	14.76	20	22.40	16.97
6	28.49	14.92	22	21.25	17.31
8	27.93	15.13	24	20.07	17.65
10	27.23	15.39	26	18.83	18.00
12	26.44	15.69	28	17.55	18.36
14	25.55	15.99	30	16.24	18.71

from which $(1 - b) = 1 - \frac{\psi a_w}{57{\cdot}3A\left(\frac{s_1}{s}\right)^2}$

where a_w is per degree.

For biplanes the following procedure for determining the downwash at the tail is suggested. From the slope of the lift curve for the particular wing find the equivalent monoplane aspect ratio by the aid of


LOADING OF BIPLANE WINGS (Equal wings)
FIG. 3
$\Theta = \frac{\Delta K_L}{K_L} = (0{\cdot}25 + 0{\cdot}020\,\phi)\frac{S}{S'}\left(\frac{1}{A} - \frac{0{\cdot}5}{A_M}\right)$
$\frac{K_{L_M}}{K_{L_L}} = m = \frac{1+\Theta}{1-\Theta}$
F(φ)
TABLE I
TABLE II
TABLE IV
The table numbers refer to N.A.C.A. report No. 458
$F(\phi) = (0{\cdot}25 + 0{\cdot}02\,\phi)$
STAGGER ANGLE TO NO-LIFT
φ°

$$\frac{A}{a_0} = 1.04\frac{A}{a_w} - .66 \text{ (Reference 7)}$$

from which

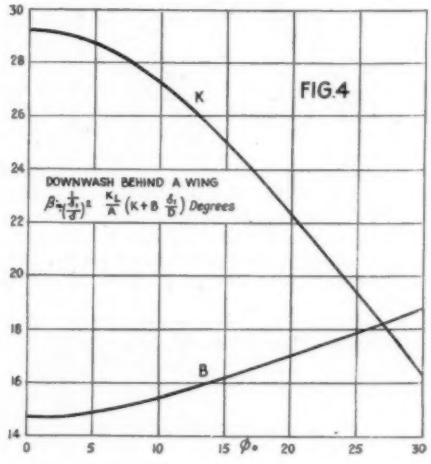
$$A = \frac{0.66}{\frac{1.04}{a_w} - \frac{1}{a_0}}$$

If a_0 is taken as 2.82 then

$$A = \frac{.66}{\frac{1}{a_w} - .3534}$$

See Fig. 8.

The downwash is then calculated for each wing separately using the appropriate values of D, s_1 and ϕ.



The total downwash at the tail is then the sum of that due to each wing taken separately.

From the empirical evidence of N.A.C.A. Report No. 539 (Reference 8) it would seem that the point of maximum downwash occurs on a plane drawn at about ⅓ the effective

incidence (i.e. the incidence from no-lift) nearer no-lift than that indicated by Glauert. That is the plane of reference, for $\phi_1 = 0$ becomes $= \frac{2}{3}a$ or $\theta = \phi_2 - \frac{2}{3}a$, where a is again measured from no-lift.

Where flaps are not fitted this line is drawn through the trailing edge of the wing and, in the case of wings fitted with a flap, the line passes through a point midway between the trailing edges of the wing and flap.

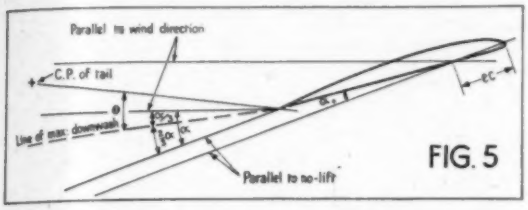


FIG. 5

To calculate a downwash with partial flaps is not attempted, as at the moment there appears to be no simple way of dealing with this, on account of the modified spanwise distribution of lift when flaps are displaced. If the downwash is calculated as though the flaps were not present then the actual downwash is usually greatly in excess of the figure obtained.

The evidence is not conclusive, but from Fig. 20 of that report the distance D is best measured from the trailing edge (see Fig. 5). In the case of a tapered monoplane the T.E. should be that of the mean lift plane.

It has been previously shown that for a rectangular monoplane (Reference 2)

$$\frac{s_1}{s} = .844\left(\frac{A}{a_0}\right) 0.054$$

where s = semi-span.

This is further approximated to by

$$s_1/s = .93\left(1 - \frac{1}{3A}\right)$$

or $s_1 = .465 \text{ span}\left(1 - \frac{1}{3A}\right)$ (see Table II)

TABLE II.

$\frac{A}{a_0}$	$\frac{s_1}{s}$	A at $a_0 = 2.83$	$.93\left(1 - \frac{1}{3A}\right)$
1.0	.844	2.83	.820
1.5	.862	4.25	.857
2.0	.877	5.66	.877
2.5	.887	7.08	.886
3.0	.896	8.49	.893
3.5	.904	9.91	.899

Glauert gives the value of $\frac{s_1}{s}$ for a straight tapered wing as

$$\frac{s_1}{s} = \frac{\pi}{4}\frac{A_1}{(A_1 - A_3 + A_5 - A_7)}$$

and, where $A = 2a_0$ the values become as in Table III.

TABLE III.

λ	$\frac{C_r}{C_0} = (1 - \lambda)$	$\frac{s_1}{s}$	$\frac{s_1's}{.876}$	$1 - .2\lambda - .08\lambda^2$
.0	1.0	.876	1.0	1.0
.25	.75	.827	.944	—
.5	.5	.772	.881	.880
.75	.25	.713	.815	—
1.0	0	.632	.722	.720

from which

$$\frac{s_1}{s} = 1 - .2\lambda - .08\lambda^2 \text{ at } A = 2a_0.$$

Assuming that the proportionate change in s_1/s with taper is independent of aspect ratio, then generally

$$s_1 = .465 \text{ span}\left(1 - \frac{1}{3A}\right)(1 - .20\lambda - .08\lambda^2)$$

The value of s_1/s for an elliptical wing is 0.785. For any other shape of wing the value of s_1/s can be fairly easily estimated from the above and by the aid of Fig. 6.

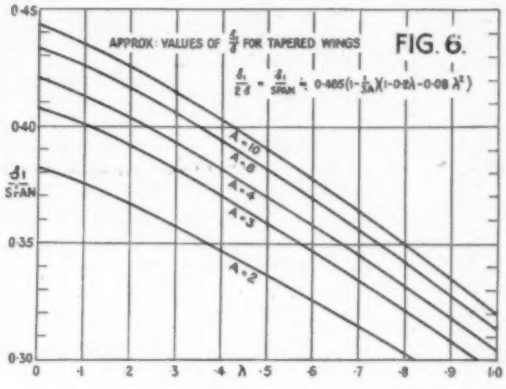


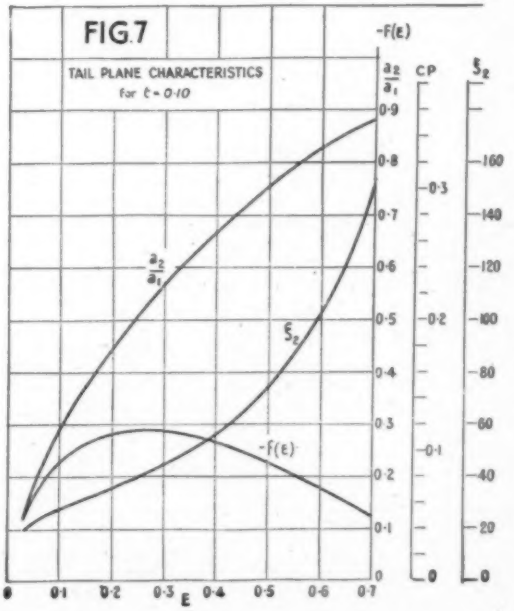
FIG. 6.

Lift Due to Tail Plane

The lift due to the tail plane is best treated on the assumption that no body is present, since the interference of the body cannot adequately be allowed for. This treatment is only comparative provided the unknown interference of the body is also comparable between one case and another.

Glauert in R. & M.'s 1.095 and 910 has given the theoretical treatment for a wing with a hinged flap and the present writer has added an empirical correction (Reference 9) based on tests on aerofoils and as applied to flaps expressed in terms of the angle of the trailing edge of the flaps in relation to their normal position.

Where the tail plane is not parallel in plan form some simplifying assumptions are necessary, unless the calculations are to become very involved. The spanwise distribution of lift is the most serious obstacle to easy computation. Owing to the modification to the flow caused by the presence of the body, it is tentatively suggested



that the lift be taken as proportional to the chord. By so doing, it is possible to work out the tail characteristics quickly and with fair accuracy.

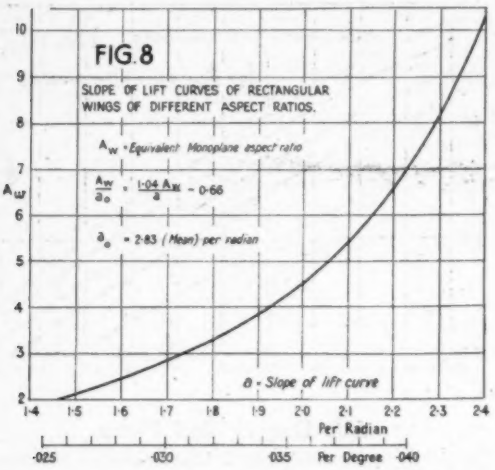


FIG. 8
SLOPE OF LIFT CURVES OF RECTANGULAR WINGS OF DIFFERENT ASPECT RATIOS.
A_W = Equivalent Monoplane aspect ratio
$\frac{A_W}{a_0} = \frac{1.04\,A_W}{a} = 0.66$
a_0 = 2·83 (Mean) per radian
a - Slope of lift curve
A_W
Per Radian
Per Degree

A summary of the results of the previous article is given below :—

$$K_L = a_1 a_t + a_2 \eta$$

where a_t = incidence of part ahead of hinge

η = angle between elevator and fixed portion.

$$K_{m0} = f(t) - f_1(E)$$

where $f(t) = 1 - 4.9t^3$

$$f_1(E) = \{ - (1 - E)\sqrt{E(1 - E)} + .0036E + .0453\,(1 - E)\}$$

$$\frac{CP}{c} = 1 - \frac{1}{.25}\frac{b_1}{a_1}\frac{1}{b_1} f_1(E) f(t) \frac{1}{57.3}$$ with elevators free.

The CP (floating elevators) for small values of E is given approximately by

$$\frac{CP}{c} = 1 - 1.54\,E$$

The slope of the lift curve with floating elevators (a_t) is given by

$$a_t = \frac{1}{\frac{1}{a_1} - \xi_1 E \frac{e}{.25}\frac{S_T}{S_E}}$$

where $e = .25 - .4t^2$

where S_T = Tail plane and elevator area

S_E = Elevator area.

$$\xi_1 = \frac{-a_2}{a_1} \cdot \frac{1}{b^1} \cdot \frac{b_1}{a_1}$$

TABLE : FOR VALUES $t = 0.10$.

E	$\frac{a_2}{a_1}$	$-f_1(E)$	CP	ξ_1	ξ_2
.03	.133	.122	.237	.584	19.45
.06	.212	.181	.225	1.452	24.2
.09	.273	.218	.2135	2.421	25.9
.10	.294	.229	.209	2.77	27.7
.15	.376	.265	.1895	4.71	31.4
.20	.447	.280	.1695	7.08	35.4
.30	.371	.288	.131	13.29	44.3
.40	.671	.265	.094	22.28	55.7
.50	.758	.226	.057	37.10	74.2
.60	.832	.176	.021	61.80	103.0
.70	.881	.121	−.009	117.80	154.0

It is the exception rather than the rule for the elevators to extend over the entire span of the tail plane. If we accept the uniform loading assumption the slope of the lift curve with floating elevators becomes

$$a_t = \frac{1}{\frac{1}{a_1} - \xi_1 \cdot \frac{e}{.25} \cdot \frac{E}{S_E/S_T}} = \frac{1}{\frac{1}{a_1} - \xi_2 \cdot \frac{e}{.25} \cdot \frac{S_T}{S_E}}$$

where S_E = elevator area

S_T = total tail plane and elevator area

and $\xi_2 = E\xi_1$.

Where the tail is tapered the value of E for reading off the graphs is taken at the mid point of the semi-span of the elevators.

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7. "Aerofoil and Airscrew Theory," H. Glauert.
8. N.A.C.A. 539. "Investigation of Full-scale Split Trailing-edge Wing Flaps with Various Chords and Hinge Locations," Rudolf Wallace.
9. *Aircraft Engineer*, October, 1935. "The Characteristics of Plain Flaps" W. R. Andrews.

TECHNICAL LITERATURE

SUMMARIES OF A.R.C. REPORTS

REPORTS published by His Majesty's Stationery Office, London, which may be purchased directly from H.M. Stationery Office at the following addresses: Adastral House, Kingsway, W.C.2; 120, George Street, Edinburgh; York Street, Manchester, 1; St. Andrew's Crescent, Cardiff; 15, Donegall Square West, Belfast; or through booksellers.

A COMPARISON OF THE DRAG OF TROUSERED AND RETRACTABLE UNDERCARRIAGES. By R. Jones, D.Sc., A. H. Bell and A. F. Brown, B.Sc., of the Aerodynamics Department, N.P.L. R. & M. No. 1691. (6 pages and 5 diagrams.) February 3, 1936. Price 1s. net.

The experiments described below were conducted at the request of the Aeronautical Research Committee on models kindly provided by the de Havilland Aircraft Co., Ltd.

It was desired to obtain typical figures for the drag of a trousered undercarriage and to estimate the gain that would result if the undercarriage were completely retracted. The best way to obtain the required data was to mount two nacelles on a standard aerofoil, first with the undercarriages of the trousered type attached, and secondly faired as they would be with a retracted undercarriage. The difference of drag could thus be obtained in the presence of a wing, thus closely representing the practical problem.

The experiments were conducted over a range of incidence in the Compressed Air Tunnel at values of R of 0.3 and 4 millions approximately.

The addition of the nacelles results in a decrease of $k_{L_{max.}}$ of about 7 to 10 per cent., with a change of about 0.8° in the no lift angle. The drag of the wing, nacelles, and trousered undercarriages is 65 per cent. greater than that of wing and nacelles, at a high Reynolds number.

NOTE ON THE STRUCTURE OF TURBULENCE IN A NATURAL WIND, CONTAINING ALSO A DESCRIPTION OF A SENSITIVE PRESSURE GAUGE. By A. Graham, M.Sc., D.I.C., of the Royal Aircraft Establishment. R. & M. No. 1704. (16 pages and 11 diagrams). January 24, 1936. Price 2s. 6d. net.

In order to extend knowledge of the structure of a natural wind the pressure fluctuations from a Dines head, mounted on the top of the wind tower at the National Physical Laboratory, were analysed by a Photo-integrating method to determine the frequency distribution of gust velocity. These experiments are described in this report together with a description of a sensitive diaphragm pressure gauge, of general utility, which was developed for the experiments.

The structure of winds prevailing at the time of the experiments having mean velocities between 10 and 15 ft./sec. was analysed and it was found that the frequency distribution of gust velocity follows very closely the normal error law.

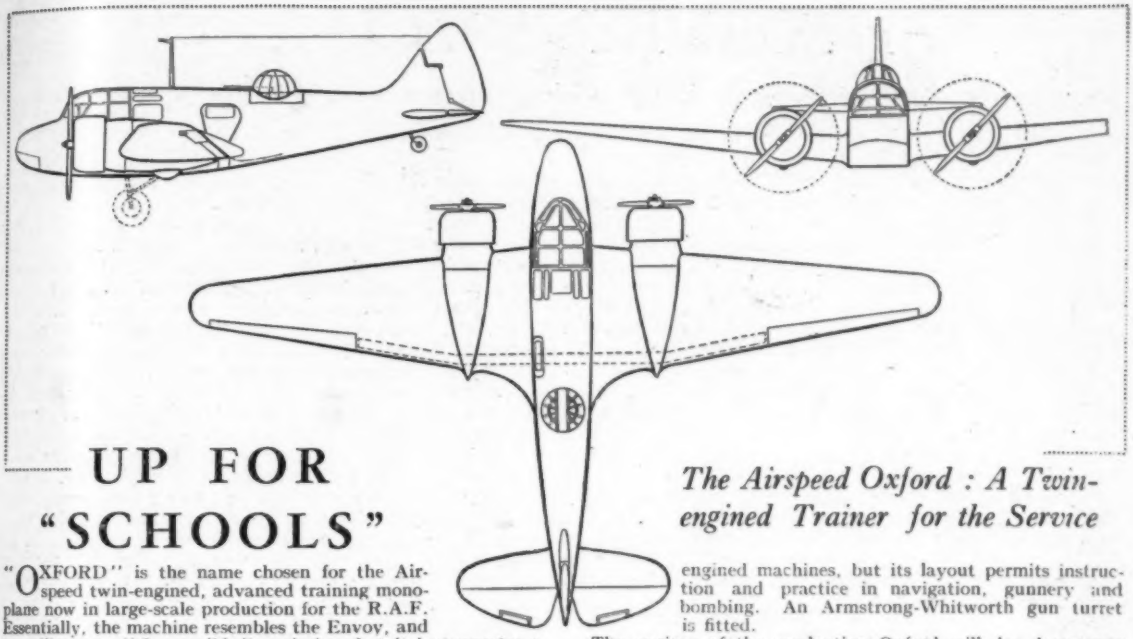
The diaphragm gauge appears to be a satisfactory instrument for recording and measuring continuous, small and rapid pressure fluctuations.

A SUCCESSIVE APPROXIMATION PROCESS FOR SOLVING SIMULTANEOUS LINEAR EQUATIONS. By J. Morris, B.A., A.F.R.Ae.S. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1711. (12 pages.) November 1, 1935. Price 2s. net.

Simultaneous linear equations of three or more variables are commonly troublesome to solve numerically. This report describes a successive approximation method of solution which has been developed as a result of work on the simultaneous equations arising in structural problems.

The process is essentially a tabular one based on the iteration principle. A detailed description of the procedure is given by reference to full examples and the conditions governing the convergence of the process are discussed. Certain special devices for the treatment of difficult cases are also mentioned.

The process is found to be of practical value, particularly for the treatment of a system of simultaneous equations in which the coefficients of the unknowns in the principal diagonal are large compared with the other coefficients. Such systems of equations are common in structural problems.



UP FOR "SCHOOLS"

The Airspeed Oxford : A Twin-engined Trainer for the Service

"OXFORD" is the name chosen for the Airspeed twin-engined, advanced training monoplane now in large-scale production for the R.A.F. Essentially, the machine resembles the Envoy, and its military or "Convertible" variation, but it incorporates a number of innovations, notably in the nose portion, where greater width permits dual control.

Not only will the Oxford be an admirable intermediate type for the training of pilots destined to fly high-performance multi-engined machines, but its layout permits instruction and practice in navigation, gunnery and bombing. An Armstrong-Whitworth gun turret is fitted.

The engines of the production Oxford will be Armstrong Siddeley Cheetah IXs, rated at 310 h.p. at 6,000ft. (350 h.p. maximum). These units will be of the newest type, adapted to drive De Havilland variable-pitch airscrews.

The first production Oxford should soon be flying.

"THE GAP"

AS propaganda for nation-wide distribution the "patriotic defence" film (*vide* preliminary publicity) *The Gap* must be highly commended. With the co-operation of the War Office and Air Ministry, Gaumont-British Instructional Films have visualised the possible results if a breach were to be left in our anti-aircraft defences in the early stages of a war with a Continental power. They show a vivid, but by no means pretty, picture.

The detail work is quite unusually good, and the whole production has that air of authenticity which could be acquired only through co-operation with the State. On the other hand there are just enough touches of low comedy, or call it what you will, to tickle the public palate and allow the rest to convince the "man in the street" that the destruction he sees might come to *his* neighbourhood should the enemy find the "gap" left by inadequate defensive forces.

There is a fair amount of flying interest—chiefly provided by "shots" of Audaxes, Heyfords and Gauntlets—and some blatant faking which, after all, was to be expected.

At a preview of the picture last week, Captain Norman MacMillan, representing the National League of Airmen, who had arranged the show by courtesy of G.B.I., maintained that not only were our ground defences inadequate, but much of our flying equipment was incapable of efficient retaliation.

Forthcoming Events

May 6. Aero Golfing Society : Instone Trophy.
May 9. R.Ae.S. Garden Party, Great West Aerodrome, Hayes.
May 12-19. Austrian Aero Club : Austrian Whitsun Flight.
May 13. Leicester Airport Coronation Air Display.
May 15. Cardiff Aero Club : Coronation Rally.
May 15-18. Yorkshire Gliding Club : Whitsun Meeting, Sutton Bank.
May 15-18. Derbyshire and Lancashire Gliding Club and Midland Gliding Club : Competition, Great Hucklow.
May 17-23. Derbyshire and Lancashire Gliding Club Training camp, Great Hucklow.
May 26—June 6. Brussels Aero Show.
May 26-30. Austrian Aero Club : Salzburg Gliding Contest.
May 27. R.Ae.S. Wilbur Wright Lecture : "Turbulence," by Dr. Theodor von Karman. Science Museum, South Kensington.
May 29. Empire Air Day.
May 29-31. London-Isle of Man Race and Round-the-Island Contests.
June 4-6. York and Leeming Club : International Meeting, York.
June 11-14. Hungarian Aero Club : International Conference.
June 12. Bristol and Wessex Aeroplane Club : Garden Party, Whitchurch.
June 15-20. Magyar Pilota Picnic, Hungary.
June 20. R.Ae.C. of Belgium : Gordon Bennett Balloon Race, Brussels.
June 21-28. Federation Aeronautique Internationale : London Conference.
June 26. Royal Air Force Display, Hendon.
June 28 and 29. S.B.A.C. Display, Hatfield.
July 1. Aero Golfing Society : *Flight* Trophy.
July 3. Newcastle-on-Tyne Aero Club : London-Newcastle Race.
July 3. Ramsgate Airport, Official Opening.
July 4-18. Aero Club of Germany : Wasserkuppe Gliding Meeting.
July 10. Cardiff Aeroplane Club : London-Cardiff Race.
July 11. Italian Aero Club : Circuit of Rome.
July 15. Aero Golfing Society : Jubilee Cup.
July 17. Portsmouth Aero Club : Garden Party.
July 23.-August 1. Swiss International Meeting.
July 24. Devon Air Day and Race : Plymouth and Exeter.
July 31. Cinque Ports Flying Club : Folkestone Aero Trophy Race.
July 31-August 2. Yorkshire Gliding Club : Opening Meeting, Sutton Bank.
August 1-14. Yorkshire Gliding Club : Instructional Camp Sutton Bank.
August 1-31. New York-Paris Air Race Flights.
August 3-September 7. Public Schools Aviation Camp, Norwich.
August 6-7. Austrian Aero Club : International Rally, Lake Worth.
August 14-22. Yorkshire Gliding Club : Open Contest, Sutton Bank.
August 21. Thanet Aero Club : Aviation Meeting and Race.
August 21. Midland Aero Club : "At Home."
August 22-29. Italian Aero Club : Circuit of Littorio.
August 28 and 29. Cinque Ports Flying Club : Lympne International Rally and Wakefield Trophy Race.
August 28-September 25. B.G.A. National Soaring Competition, Great Hucklow.
September 10-11. R.Ae.C. : King's Cup Race.
September 12. Aero Club de France : Coupe Deutsch de la Meurthe, Etampes.
September 23. Aero Golfing Society : Cellon Trophy.

SURVEY SPECIAL

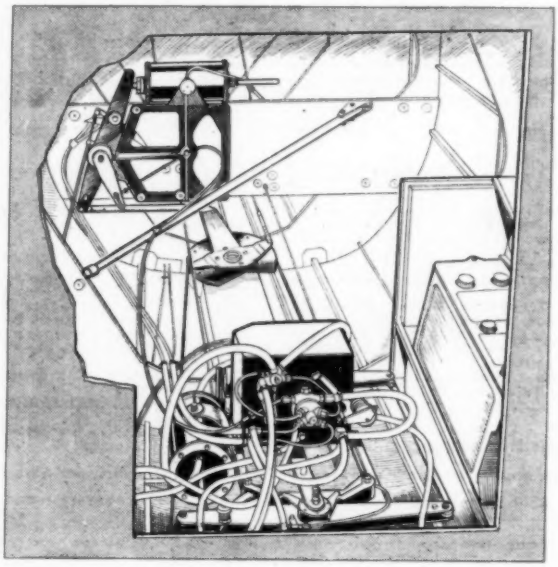
Details of the B.A. Double Eagle Which is Being Built for Air Survey Work in Africa : How the Special Equipment is Laid Out

THERE is always a great deal of interest surrounding any machine which is being built to special order, and when this order has been given by a large organisation devoted to work as specialised and precise as photographic air survey the interest is naturally multiplied. During the past few years the aeroplane has come to be almost universally used for all forms of large-area survey, and the technique involved has necessitated the use of very specially equipped machines.

It has been found that no human pilot, however skilful, can hold a machine with the absolute steadiness which is so essential for rapid and economical work with a survey camera. When it is remembered, for instance, that the machine must, for successful work, be kept laterally steady to within one degree the need for a three-axes automatic pilot which is both reliable and constant in action can be realised. The arrival of such instruments has largely solved this particular problem, but it has been found that normal equipment and machine layout have to be modified so drastically that it is now worthwhile to start at the beginning, so to speak, and to design a machine solely for survey work.

Some time ago The Aircraft Operating Co. of Africa (Pty.), Ltd.—an associated company of H. Hemming and Partners, Ltd.—placed an order for such a machine with the British Aircraft Manufacturing Co. The specification demanded the installation of a three-axes automatic pilot system, a vertically mounted camera and a great deal of special equipment, while it was necessary for the pilot to be provided with an exceptional field of view, particularly in the downward direction; and, since the machine was to be operated at a considerable height, a special heating system had to be devised both for the photographer and camera. Naturally enough, the machine had also to be designed so that it would be capable of reaching operating height in as short a time as possible; of holding a reasonably high cruising speed at this height; of flying, if necessary, on one engine; and of staying in the air for a period long enough to complete a satisfactory day's work before a descent had to be made.

This special machine has been based on the Double Eagle, and, generally speaking, the structure remains unaltered. In order to provide the pilot with an even better range of vertical visibility the fuselage has been slightly narrowed and the windscreen redesigned. The latter is an extraordinarily deep and almost one-piece affair in Perspex, moulded by Triplex. Basically, however, the Double Eagle, with its "high-middle-wing" design and its "inverted-triangle-section" fuselage, appeared to be ideal for the purpose, and any modifications have concerned only the installation of the equipment.



A view through the rear bulkhead, looking towards the tail of the machine and showing the position of the rudder and elevator automatic pilot units and the battery, which is normally boxed in so that no fumes shall upset the operation of the automatic pilot units.

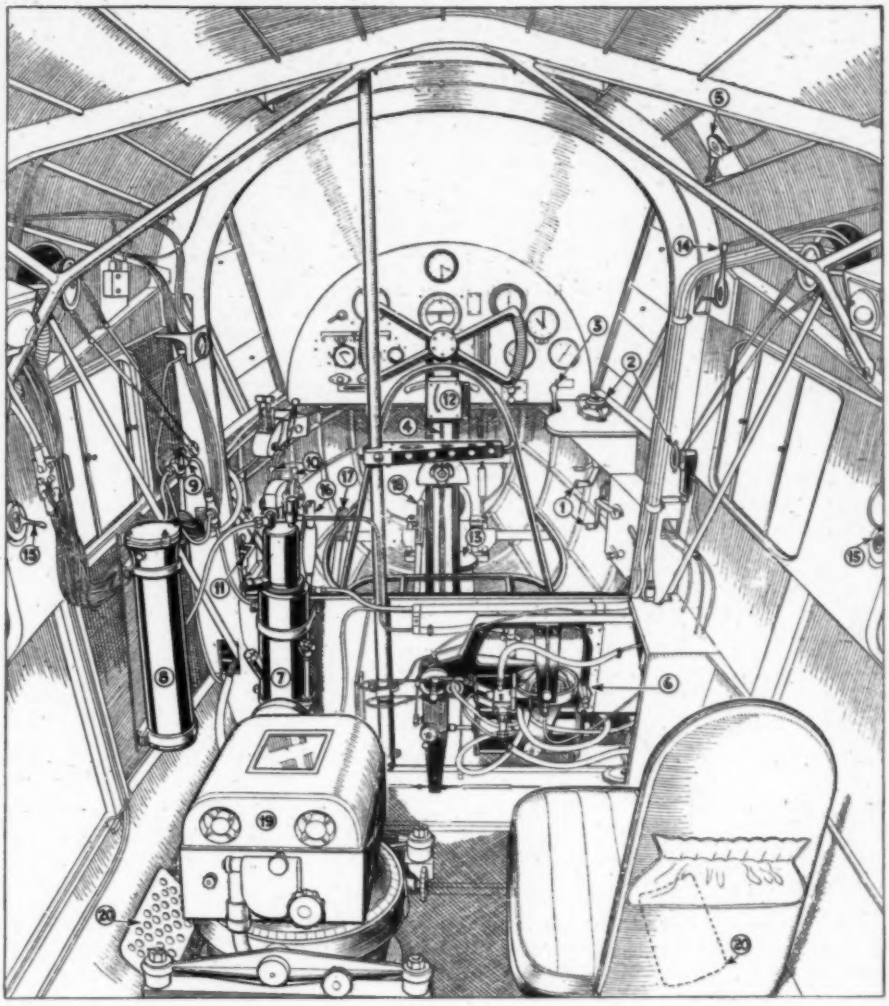
In order that the machine shall have the necessary performance, both in the matter of climb and cruising speed, it has been fitted with the latest type of Series II Gipsy Sixes with D.H. variable-pitch airscrews, giving it a cruising speed of about 160 m.p.h. at 16,000ft., with an endurance of five to six hours. The main fuel tanks are in the wings, but there is an additional tank in the cabin on the port side, which also acts as a "distributor," the supply being fed to this by gravity from one or other of the wing tanks and then pumped to the engines. In this way all tanks are available for feeding either engine in the unlikely event of failure. The necessary gauges, of Korrect and Smith's manufacture, are mounted on the dashboard. The oil tanks are, of course, in the engine nacelles, each having its special cooling scoop. Outboard of the engine, on each side, are a generator and an air compressor, each being windmill-driven, and the latter having a brake so that it may be put out of action when not required for supplying the automatic pilot units. Mounted in the nose of the machine is a Harley landing light, which is adjustable over a wide range by a lever on the pilot's left.

The "Innards"

So much for the "exterior" equipment. At first sight the interior of the pilot's cockpit appears as a somewhat bewildering mass of control detail, but on further examination it is seen that every control and instrument is most conveniently placed, and that a great deal of thought must have been given to this placing in such a comparatively confined space. All the controls, both for direct operation and for automatic pilot adjustment, are arranged so that the movements are natural and their position is such that the pilot's hand would automatically find them.

Dealing with the control column first, there is, just below the "spectacles," a large knurled handwheel and a directly visible indicator for fore-and-aft trimming. This placing of the trimmer on the Double Eagle has not, so far as we know, ever been attempted on a large type of machine, and should be most convenient and natural in operation. Below this, on the column itself, there is a transversely moving lever for the adjustment of the lateral axis pilot, and on the floor, at the base of the column, there is another knurled handwheel—this time with a vertical axis and an appropriate indicator—for direct rudder trim adjustment.

On the pilot's right there is another lever, moving in a fore-and-aft direction, for the adjustment of the automatic elevator control. Beside it there is a small wheel for coarse adjustment of the directional pilot. For really fine adjustment of the same pilot there is another wheel on the pilot's right and slightly behind him. With



This sketch of the interior of the "survey" Double Eagle not only shows the majority of the control and other details but also gives a good indication of the field of view provided for the pilot, whose seat is shown in skeleton form. The first nine of the key numbers below apply to the automatic pilot equipment.

(1) Main control and catch lever. (2) Coarse and fine directional adjustment controls. (3) Fore and aft control. (4) Lateral control. (5) Air-driven compressor brake lever. (6) Aileron pilot unit. (7) Oil reservoir. (8) Air drier. (9) Test cock. (10) Airscrew pitch controls. (11) Undercarriage and flap controls. (12) Fore and aft trimmer. (13) Directional trimmer. (14) Drift sight control. (15) Heater controls. (16) Seat-raising lever. (17) Undercarriage and flap pump lever. (18) Brake lever. (19) Camera. (20) Heater grilles.

the exception of the latter, all these direct and automatic pilot controls move in the appropriate direction or manner according to the particular adjustments which are being made.

Beside the pilot's seat, on the left, there is a quick-action seat-adjustment lever and another lever operating the hydraulic pump for raising or lowering the undercarriage and/or flaps. Both the undercarriage and the entire hydraulic operating gear have been made by Dowty. The change-over lever, with its clearly marked movement guide, is on the pilot's left, behind the throttle gate and the pair of v.p. airscrew operating levers.

The operating lever for the Dunlop braking system is placed just beside the control column, and this system includes the installation of the latest type of differential control whereby a movable link, connected to the rudder bar, causes one or other of the two pneumatic valves to feed more or less air under pressure to the two wheel brakes.

The Automatic Pilot

The three units of the Smith automatic pilot are disposed in the fuselage according to their particular work and to the desired weight distribution. The lateral control unit is placed at the forward end of the cabin immediately behind the pilot's seat, while those for the rudder and elevator controls are mounted behind the cabin in the space normally used for the accommodation of luggage. There also is the heavy-duty accumulator, which is arranged in a gas-tight and ventilated box so that no fumes shall interfere with the working of the rudder pilot which is arranged just beside it.

The camera is mounted on the port side of the machine immediately aft the aileron pilot, and the operator's seat is arranged beside it on the starboard side so that he can communicate with the human pilot without the necessity for speaking tubes.

Very careful attention has been paid to the heating and ventilation system in the cabin. Each exhaust pipe is arranged with a by-pass to a muffler surrounding an inlet pipe through which the air flow passes on the way to the cabin, where the heated air is directed on to the camera itself and its operator. A butterfly valve is fitted behind each muffler, so that when no heat is required the air can pass straight through the heated pipe. Controls for these valves are placed on each side of the cabin and within reach of the camera operator.

Ventilation and Heating

Fresh air is fed through a duct in the centre section fillet on each side, and its flow is adjustable inside the cabin by means of the normal punkahs. Continuous circulation of either hot or warm air is made possible by the fitting of four rearward-facing cowled outlets each with its own drain pipe—the latter ensuring that no rain shall enter the cabin even when the machine is parked tail to wind in bad weather. These fittings give some small indication of the amount of thought which has been expended on the planning of the entire layout of this extremely interesting machine.

After it has passed the necessary tests the survey Double Eagle will be flown out to Africa by Mr. Brian Russell, the Aircraft Operating Company's chief pilot, with Mr. C. D. Corse, the manager of the company, as passenger for the trip.

THE ROYAL AIR FORCE

SERVICE NOTES AND NEWS — AIR MINISTRY ANNOUNCEMENTS

FROM HAMPSHIRE TO YORKSHIRE : The Lawrence Minot Trophy, competed for annually by heavy bomber squadrons, once lived for years on end at Worthy Down, where it was won each year by either No. 7 or No. 58 (Bomber) Squadron. This year it has been won by No. 215 (B) Squadron, stationed at Driffield. This group shows the winners and the Trophy. Names L. to R. :—Back row, A.C.1 Carrot, L.A/C. McNichol, A/C.1 Berry. Front row, Sergt. Chown, Sqn. Ldr. J. L. Kirby, Sergt. Burrows, L.A/C. Darbyshire.

NEW SQUADRON FORMED

No. 62 (Bomber) Squadron formed at Abingdon on April 12 and will be equipped with medium bomber aircraft. The unit has been placed in the Bomber Command, in No. 1 (Bomber) Group.

MOVES OF SQUADRONS

No. 226 (Bomber) Squadron moved from Upper Heyford to Harwell on April 16.

No. 38 (Bomber) Squadron will move from Mildenhall to Marham on May 5.

AUXILIARY AIR FORCE UNITS

No. 607 (County of Durham) (Fighter) Squadron and No. 608 (North Riding) (Fighter) Squadron will be transferred to the Fighter Command and placed in No. 12 (Fighter) Group with effect from May 5.

PROMOTION TO SQUADRON LEADER

The prescribed seniority as flight lieutenant qualifying for promotion will be reduced from five to three years, with effect from June 1, until further notice. The qualifying period allowing an officer to sit for the flight lieutenant promotion examination "C" will be reduced from three to two years in the rank until further notice.

MOVE OF No. 5 FLYING TRAINING SCHOOL

No. 5 Flying Training School will move from Sealand to Hullavington. The move is to be completed by July 9.

The R.A.F. Station, Hullavington, will be placed under the command of the A.O.C.-in-C. Training Command in No. 23 (Training) Group with effect from June 4. The postal address is: Stanton St. Quinton, Chippenham, Wilts.

A station headquarters will form at Sealand on June 1 and will take over executive command of the station on a date to be notified later. On the move of No. 5 Flying Training School from Sealand, the station will be transferred to the Bomber Command and placed in No. 2 (Bomber) Group. The Packing Depot will also be transferred to the Bomber Command but the present system of administration will not be changed.

OPENINGS FOR 1,300 BOYS

Tuesday next is the closing day for applications for the 1,300 posts which the Air Ministry is now offering to well-educated lads between the ages of 15 and 17. They will enter the Royal Air Force as aircraft apprentices in August next. After three years' thorough training as fitters, wireless operator mechanics, or instrument makers, they go to operational squadrons, flying training schools or workshops, where they are employed as highly skilled tradesmen. For some of them there are opportunities to fly as one of an aeroplane crew and for others a chance to become a pilot.

Apprentice training takes place at splendidly equipped technical schools at Halton, Bucks, and Cranwell, Lincs. The popularity of the scheme is evident from the fact that 5,000 apprentices are at present under training.

Immediate application for particulars of the scheme should be made to any schoolmaster or to the Air Ministry (Dept. I. of R.), London, W.C.2.

FORMATION OF STORAGE UNIT

No. 3 (M.T.) Storage Unit formed at Mousehold, Norwich, on March 30, and was placed in the Training Command, in No. 24 (Training) Group, with effect from that date.

No. 45 SQUADRON DINNER

The organisers of the No. 45 Squadron dinner are Mr. Bernard Weatherall, 146, Prince's Road, Brockhurst Hill, Essex, and Mr. Howard W. Grimmett, 18, Leyland Road, Lee, London, S.E.12, from whom further particulars can be obtained. The cost of the dinner will be 3s. 6d.

EXTENSIONS OF SERVICE

The undermentioned pilot officers have been selected for extension of service to complete six years on the active list:—

Allan Stuart Ainslie, Bryan Bell, John Rutherford Irving Bell, William Hugh Biddell, Charles Beresford Eaton Burt-Andrews, John Butterworth, Peter Douglas Dudley Carlton, Wilfrid Allen Lance Davis, Alexander Charles Douglas, Charles Ernest Drapper, James Nigel Watts Farmer, Jeaffreson Herbert Greswell, Peter Hadfield, Jack Donald Harris, Anthony Hibberd, Caesar Barraud Hull, Geoffrey Cockayne Hyde, Charles Edward Johnson, Robert Nugent Lambert, Malcolm John Loudon, Geoffrey Lowe, Vivien Elliott Marshall, Thomas Frederick Dalton Morgan, William George Moseby, Michael George Foster Pedley, Ronald Anthony George Petrie, George Hugo Formby Plinston, Denis Dimond Rawlins, Peter Henry Rebbeck, Arthur James Robinson, William Riley, Frederick Ernest Rosier, Barnard Johnston Sandeman, Kenneth Slater, Harold Wray Tennant, Frank George Ralph Thomas, John Gordon Towle, John Stewart Tupholme, John Warre Bradney Vernon, Peter Russell Walker, Richard Kemp Wildey, Geoffrey Middleton Wyatt.

FLYING IN VICINITY OF CIVIL AIRPORTS

A number of complaints have been received with regard to Service aircraft flying in the vicinity of civil airports in conditions of low cloud or poor visibility, thereby causing danger to civil aircraft approaching on radio bearings. The attention of all pilots is drawn to Notice to Airmen No. 158/1936, and especially to paras. 10 and 11 thereof. Pilots are to note that a controlled zone exists around all the civil aeronautical ground stations mentioned in the *Air Pilot*, part I, pages 50, 51 and 52, with the exception of Jersey and Pulham.

FLYING ACCIDENTS

The Air Ministry regrets to announced that A/C.1 George Peter Smurthwaite lost his life in an accident which occurred near Waldringfield, Suffolk, on April 19, to an aircraft of the Aeroplane and Armament Experimental Establishment, Martlesham Heath. A/C.1 Smurthwaite was a passenger in the aircraft, which was piloted by Flight Lieut. Maurice Hare, who received slight injuries.

The Ministry also regrets to announce that Cpl. Walter Kirby Jackson lost his life in an accident which occurred at Portmadoc on April 23 to an aircraft of No. 6 Flying Training School. Cpl. Jackson was the pilot of the aircraft. The only other occupant, L.A/C. Leonard Hopkirk, escaped with slight injuries.

ROYAL AIR FORCE GAZETTE

London Gazette, April 20, 1937

General Duties Branch

J. R. MacLachlan is granted a permanent commission as **Pilot Officer** with effect from May 26, 1934, and with seniority of November 26, 1932 (substituted for notification in the *Gazette* of June 5, 1934).

The following Pilot Officers on probation are confirmed in their appointments (February 5):—M. J. Loudon, R. R. S. Tuck.

Acting Pilot Officer on probation D. L. Rayment is confirmed in his appointment and graded as Pilot Officer (December 24, 1936).

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—J. R. MacLachlan (seniority October 1, 1936) (November 26, 1936) (substituted for notification in the *Gazette* of December 1, 1936); H. J. F. Le Good (March 12); V. W. Glasheen (March 15); J. P. Selby (March 16); J. H. Becher (seniority October 1, 1936) (March 29); J. R. L. Rumsey, E. P. P. Gibbs, W. B. Fleming (April 2); C. F. Pearce (April 9).

The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—J. R. MacLachlan (seniority of May 26, 1934) (November 26, 1934) (substituted for notification in the *Gazette* of May 28, 1935); W. E. Surplice (March 14); A. J. F. Churchill (April 19).

Lt. J. Casson, R.N., Flight Lieutenant, R.A.F., ceases to be attached to the R.A.F. with effect from March 11 on return to Naval duty, and is reattached to the R.A.F. as a Flight Lieutenant with effect from March 24 and with seniority of January 1; Lt. H. E. R. Torin, R.N., Flying Officer, R.A.F., ceases to be attached to the R.A.F. with effect from March 15 on return to Naval duty, and is reattached to the R.A.F. as a Flying Officer with effect from March 24 and with seniority of May 22, 1934; Sqn. Ldr. A. P. Maurice, D.F.C., is placed on the retired list (April 18); F/O. C. C. Byar is transferred to the Reserve, Class A (March 25); P/O. D. J. North-Bomford resigns his short service commission (April 1).

Equipment Branch

The following Warrant Officers are granted permanent commissions as Flying Officers on probation with effect from and with seniority of April 12:—E. F. Curtis, J. S. Eley, F. H. J. Heading, H. Lovegrove, E. A. Rabbits, D. Stacey, H. F. Thomas, A. C. Thorne, D. Yellowley.

The following airmen are granted permanent commissions as Pilot Officers on probation with effect from and with seniority of April 12:—590084 Cpl. J. S. Atkinson, 590024 Cpl. A. R. Chrisp.

Pilot Officer on probation D. H. M. Graham is confirmed in his appointment and promoted to the rank of Flying Officer (January 6).

Accountant Branch

Flying Officer on probation H. E. J. Acfield is confirmed in his appointment (March 16).

Medical Branch

F/O. H. C. de B. Milne, M.R.C.S., L.R.C.P., is promoted to the rank of Flight Lieutenant (March 10); Flt. Lt. H. J. Melville, M.B., Ch.B., is transferred to the Reserve, Class D (April 18).

Commissioned Engineer Officer

Flying Officer on probation J. K. Tough is confirmed in his appointment (March 18).

Commissioned Armament Officer

Flying Officer on probation A. J. Richardson is confirmed in his appointment (March 23).

PRINCESS MARY'S ROYAL AIR FORCE NURSING SERVICE

Staff Nurse Miss A. M. Trotter is promoted to the rank of Sister (April 14).

ROYAL AIR FORCE RESERVE

Reserve of Air Force Officers

General Duties Branch

The following are transferred from Class A to Class C on the dates stated:—Flt. Lt. G. V. T. Thomson (February 23); F/O. C. Gardner (August 4, 1936).

F/O. G. S. Ogilvie is transferred from Class AA (i) to Class C (September 9, 1936); F/O. P. B. H. Home is transferred from Class AA (i) to Class C (July 26, 1936) (substituted for notification in the *Gazette* of February 16).

The following Flying Officers are transferred from Class AA (ii) to Class C on the dates stated:—F. W. Moss, F. G. Woodward (March 14); D. Beevers, J. G. Giddins (March 16).

F/O. B. L. Young is transferred from Class C to Class A (March 23); Flt. Lt. H. R. B. Howell, Lt.-Cdr., R.N., ret., relinquishes his commission on completion of service and is permitted to retain his rank (April 10).

The following Flying Officers relinquish their commissions on completion of service on the dates stated:—E. G. Banham (March 16); R. G. Grant (March 17); G. I. F. Thomson (March 22).

Flt. Lt. J. G. Murray relinquishes his commission on account of ill-health and is permitted to retain his rank (April 21).

AUXILIARY AIR FORCE

General Duties Branch

No. 504 (COUNTY OF NOTTINGHAM) (BOMBER) SQUADRON.—J. S. Owen is granted a commission as Pilot Officer (February 22).

No. 601 (COUNTY OF LONDON) (FIGHTER) SQUADRON).—G. I. Cuthbert is granted a commission as Pilot Officer (March 18).

No. 603 (CITY OF EDINBURGH) (BOMBER) SQUADRON.—J. A. B. Somerville is granted a commission as Pilot Officer (January 14). (Substituted for notification in the *Gazette* of March 12.)

No. 610 (COUNTY OF CHESTER) (BOMBER) SQUADRON.—G. L. Chambers is granted a commission as Pilot Officer (March 1).

Equipment Branch

Flt. Lt. J. Hobbs (R.A.F., retired) relinquishes his commission on cessation of duty (November 16, 1936).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified:—

General Duties Branch

Wing Commanders.—T. S. Ivens, to No. 1 Armoured Car Company, Hinaidi, Iraq; to command, 8.3.37. R. S. Aitken, M.C., A.F.C., to D. of Sigs., Dept. of C.A.S., Air Ministry; for Signals duties, 12.4.37. R. T. B. Houghton, A.F.C., to R.A.F. Station, Upwood; to command, 12.4.37. C. L. Scott, to Headquarters, No. 2 (B) Group, Andover; for Air Staff duties, 29.3.37.

Squadron Leaders.—A. C. Stevens, to Headquarters, No. 4 (B) Group, Mildenhall; for Air Staff duties, 7.4.37. R. N. Waite, to No. 224 (G.R.) Squadron, Boscombe Down; to command, 3.4.37. A. B. Woodhall, to No. 824 (T.S.R.) Squadron; to command, 1.4.37. A. H. Owen, M.C., to No. 4 Flying Training School, Abu Sueir, Egypt; for duty as Flying Instructor, 17.3.37. J. F. T. Barrett, D.S.O., D.F.C., to No. 8 (B) Squadron, Aden; to command, 11.3.37. C. H. A. Stevens, to No. 84 (B) Squadron, Shaibah, Iraq; to command, 12.3.37.

Flight Lieutenants.—R. C. Gaskell, to No. 813 (T.S.R.) Squadron, 1.4.37. J. D. Miller, to No. 824 (T.S.R.) Squadron, 1.4.37. G. P. Charles, to Headquarters, R.A.F., Hinaidi, Iraq, 10.3.37. Viscount Acheson, to No. 48 (G.R.) Squadron, Manston, 25.3.37. R. N. Clarke, to No. 217 (G.R.) Squadron, Boscombe Down, 28.3.37. W. A. J. Satchell, to R.A.F. Station, Calshot, 28.3.37.

Flying Officers.—F. B. Chapman, to No. 217 (G.R.) Squadron, Boscombe Down, 28.3.37. C. S. Cooper, M. E. W. Scott-Mackirdy, to No. 813 (T.S.R.) Squadron, 1.4.37. T. M. Buchanan, F. O. Dickson, No. 824 (T.S.R.) Squadron, 1.4.37. W. O. Jones, to Headquarters, R.A.F., Palestine and Transjordan, Jerusalem, 11.3.37. G. L. Cruickshanks, to No. 45 (B) Squadron, Helwan, Egypt, 23.3.37.

Pilot Officers.—A. Flowerdew, to No. 55 (B) Squadron, Hinaidi, Iraq, 15.3.37. D. O. F. Lumsden, to No. 813 (T.S.R.) Squadron, 1.4.37. R. H. M. Heriot-Hill, to No. 824 (T.S.R.) Squadron, 1.4.37. N. M. Boffee, to No. 75 (B) Squadron, Driffield, 14.3.37. P. F. Rutter, to No. 166 (B) Squadron, Ledonfield, 14.3.37. E. A. Liversidge, to No. 58 (B) Boscombe Down, 14.3.37. G. O. Mills, to No. 75 (B) Squadron, Driffield, 14.3.37. D. R. Chance, to No. 97 (B) Squadron, Leconfield, 14.3.37. I. M. Brodie, J. H. Chaplin, D. Ford, E. J. S. Jones, F. E. R. King, to R.A.F. Station, Calshot, 28.3.37. J. A. Bateson, J. S. Kendrick, to No. 217 (G.R.) Squadron, Boscombe Down, 28.3.37. J. M. Downton, S. R. Gibbs, P. R. Woodward, to No. 220 (G.R.) Squadron, Bircham Newton, 28.3.37. F. E. Burton, to No. 224 (G.R.) Squadron, Boscombe Down, 28.3.37. L. M. Blome-Jones, to No. 55 (B) Squadron, Hinaidi, Iraq, 2.3.37.

Acting Pilot Officers.—The undermentioned are posted to No. 7 Flying Training School, Peterborough, with effect from 20.3.37:—R. A. Couchman, F. G. Dutton, G. Harries, L. H. McFarlane, W. S. Barton, D. W. Reacher, H. M. Selwyn, J. R. Bland, M. J. Brady, H. G. Muller, G. Packe, D. D. Pryde, R. E. Smissen, P. R. Barr, I. N. Bonard, J. T. Heath, R. Moseby, P. L. Burke, D. F. A. McBain, J. A. D. Sturges, P. D. Dear, W. P. Green, E. V. Hulbert, J. Adams, P. J. R. Kitchin, J. H. Newberry, D. A. Peacock, R. Sawrey-Cookson. W. G. Craddock, to No. 224 (G.R.) Squadron, Boscombe Down, 28.3.37. R. H. Balls, to No. 5 Flying Training School, Sealand, 29.3.37.

The undermentioned are posted to No. 5 Flying Training School, Sealand, with effect from 20.3.37:—J. L. Calvert, G. D. Clancy, J. S. Davies, B. W. Hayward, O. G. Horrigan, E. J. Kain, R. J. MacDonogh, A. S. Mirylees. R. E. Sperling, A. C. Taylor, W. D. Corr, H. D. H. Cooper, D. C. Garton-Stone, J. Hobbs, N. R. Irving, E. W. Lockwood, D. D. McPetrie, J. A. Pimlott, D. A. Strachan, J. W. G. Wellham, S. B. Baldie, J. L. Ellis, N. M. Harding, R. T. Hunn, G. K. H. Maitland, J. C. Milner, J. Read, J. M. Strickland, J. H. Welford, A. F. Riddlesworth, L. R. Cohen, A. R. Holmes, H. G. Graham-Hogg. A. M. G. Lywood, B. D. F. MacLaren, J. D. W. Murray, H. M. Robertson, R. C. B. Swinden, J. H. Walker, and P. A. Wimberley.

Equipment Branch

Wing Commanders.—A. W. Smith, to No. 11 Equipment (Ammunition) Depot, Chilmark; to command, 12.4.37. H. B. S. Ballantyne, to No. 11 Equipment (Ammunition) Depot, Chilmark, for equipment duties, 12.4.37.

Flight Lieutenants.—G. C. Allen, to No. 2 Equipment (Ammunition) Depot, Altrincham, 12.4.37. A. A. Quayle, to No. 11 Equipment (Ammunition) Depot, Chilmark, 12.4.37.

Flying Officer.—C. E. Lindsell, to No. 2 Equipment (Ammunition) Depot, Altrincham, 12.4.37.

Accountant Branch

Flight Lieutenant.—N. Wallett, to D. of E., Dept. of A.M.S.O., Air Ministry, 15.3.37.

Commissioned Armament Officers

Flying Officers.—A. Davidson, to No. 1 Armament Training Camp, Catfoss; on appointment to a Permanent Commission as Flying Officer (Commissioned Armament Officer), on probation, 22.3.37. J. J. Burton, to Reception Depot, West Drayton; on appointment to a Permanent Commission as Flying Officer (Commissioned Armament Officer), on probation, 22.3.37.

COMMERCIAL AVIATION

— AIRLINES — AIRPORTS —

PROLETARIAN INTEREST : Californians cast a critical eye over a Douglas DF flying boat (two 850 h.p. Cyclone Gs) for Soviet Russia. The outboard floats are retractable. A maximum speed of 178 m.p.h. is claimed and the disposable load is 11,185 lb.

THE WEEK AT CROYDON

Coronation Visitors and Preparations : Still More Charter Business : Another Cape Attempt

CORONATION, Co-operation and Conferences seemed to be the main themes of Croydon activities last week. The first had already brought many visitors, some by ordinary services and others by special aeroplane, among the latter being the Maharajahs of Jodhpur and Jaipur, who had a special K.L.M. Douglas right through from India. Undoubtedly air transport makes a strong appeal to these Oriental potentates, for, apart from speed and comfort, the privacy which the maintenance of *purdah* requires is easily obtained; the Maharanee of Jodhpur simply walked down a covered gangway straight into her *purdah*-glazed limousine with the minimum of inconvenience to all concerned.

Imperials, too, have had their quota of notabilities, including a Sultan from Lahej (my geographic knowledge is sadly lacking here) [Aden.—ED.] and many Britishers "homing" from South Africa and various parts of their route from Australia.

Scylla went into service on one of the pleasant summer-like days of the week, complete with Lorenz gear—which presumably satisfies both pilots *and* the "ice-and-fog" brigade of the House of Commons!

Sightseeing in Comfort

Olley Air Service report "charters to all points of the compass" and very favourable bookings for the Coronation night flights, and Surrey Flying Services have expectations of beating their Jubilee Week night-flight figures. They have completed the erection of the Beechcraft for Jim Haizlip, who has tested it with evident satisfaction. Surrey's are also looking after Prince Cantacouzene's Caudron Typhon, which made a dusk landing preparatory to cracking off at dawn from Hatfield on a Cape record attempt. A Roumanian by nationality and a nephew of Prince Bibesco, this young man is most thorough in his preparations. The Surrey hangar is so full that, by the kindness of Personal Airways, they have "overflowed" into the latter's hangar, but as Personals have been busy with charters these temporary measures have not inconvenienced them.

Capt. Ledlie made two trips to Cannes, one with Lord Beattie, not to mention nine flights to Newmarket, when the passenger lists included such familiar names as Gordon Richards, A. Richardson, Steve Donoghue, and George Duller.

Air Dispatch have just obtained Air Ministry "approval" for their shops, and rejuvenated Avro 504s for circus work have been seen to emerge with regularity associated with the production of Empire boats. Their Le Touquet service is already well booked up for Whitsun.

Nocturnal Safety

In connection with Coronation night flying, conferences have been taking place between operating companies and Air Commodore Robertson and his assistants, and it is probable that if some of the suggestions put forward at these meetings are found to work out in practice they may regularly be adopted with Air Ministry approval. As there are likely to be upwards of a dozen aircraft all attempting to land at once, the main idea is to obviate the necessity for distracting a pilot's attention with signals, visual or otherwise, made from the control tower; he can thus devote himself to keeping a pair of watchful eyes on the doings of "the other fellows."

"A. Viator" (for whom I am deputising this week) tells me that Capt. Leverton, the K.L.M. manager, has been subjected to an enforced holiday by his medical advisers, and his friends at Croydon wish him a speedy recovery.

T. A. R. MAC.

Lockheeds for Roumania

TO be used on services from Bucharest to Gdynia and Warsaw, and to Sofia, Salonika and Athens, the Roumanian company Industria Aeronautica Romana has ordered four Lockheed Electras. One has already been shipped across.

K.N.I.L.M. Multiplication

DURING this summer the weekly K.N.I.L.M. Java-Bali and Java-Borneo services will be duplicated, fast twice-weekly Batavia-Sourabaya runs will be made, and a third service in the afternoon between Batavia and Bandoeng will be maintained.

More 220s for Air France

IN Paris the new Marcel Bloch 220 is regarded as the French reply to the American Douglas D.C.3, which carries 21 passengers, a crew of two and a hostess, as against the Bloch's 16 passengers, a crew of two and a steward. On the scores of take-off and landing speed the Bloch shows marked improvements on other French machines, and conforms closely with the D.C.3. Last week we mentioned that the prototype was doing its 100 hours' "run in" before being put into service, and that Air France had five more on order. Since then, more than 50 hours of this "running-in" have been completed by Lionel de Marmier, and on the strength of his reports a further eight machines have been ordered, bringing Air France's total number of these new machines up to fourteen.

Jersey Airways' Summer

DURING their fourth year of operation Jersey Airways will be running, in addition to their Southampton- and Heston-Jersey services, daily services between the island and both Exeter and Brighton, as well as a feeder service between Jersey and Alderney.

Last year, it may be remembered, the company's main "lines" made a call at Alderney, and a service between Plymouth and Jersey was run more or less experimentally. Exeter's airport at Clyst Honiton, some four miles from the city, is due to be opened next month. Needless to say, the new airport at St. Peters, Jersey, adds a certain dignity to the 1937 operations, and passengers have all the rail-air advantages to be obtained from co-operation with R.A.S.

Subsidiary Deputation

LAST week Sir Philip Sassoon and Sir Francis Shelmerdine received a deputation representing local authorities and others owning or contemplating the provision of aerodromes or operating air services in the eastern area of England and in Scotland.

This deputation was introduced by Mr. A. Short, M.P., and included, among others, Councillor Bateman, the chairman of the Aerodrome Owners' Association, Lord Grimthorpe, of North-Eastern Airways, Mr. Whitney Straight, and representatives of the Doncaster, Grimsby, Leeds and Perth Corporations.

Their previously considered resolution urged the Government not to legislate in a manner detrimental to the interests of the aerodrome and air service operators on the east of the Pennines (*vide* the Maybury Report), to provide financial assistance towards the establishment and maintenance of aerodromes and air services, and to exempt from tax all petrol used for the purposes of aviation.

Whilst undertaking to bring these suggestions to the notice of the Secretary of State, Sir Philip explained that it would be impracticable to go beyond the recommendations of the Maybury Committee in the matter of financial aid.

Combating Ice

THE D.H.86 which has recently been fitted with Dunlop Anticers to the order of Imperial Airways is now ready for practical test work. Already work at Martlesham has proved that the aerodynamic qualities of the machine have not been impaired and the equipment itself will now be tested under conditions approaching service flights.

The Dunlop device, which was originally developed at Farnborough, has as its principle, it may be remembered, the forcing of ethelyne glycol through rubber tubes fitted along the leading edges of wings and struts and out through vents in the tubes to the surfaces likely to be affected by ice. This system was tested experimentally by Imperial Airways some time ago. A difficulty then, however, was the provision of adequate and even distribution of the liquid, but it is believed that the improved equipment now to be used will overcome this difficulty.

Another method of ice prevention by chemical means has also been used by Imperial Aidways. In this a special paste known as "Kill-frost" is smeared on the parts likely to be affected, including airscrews, and is capable of preventing water from freezing even during extended flights.

African Survey

ON Monday the Imperial boat *Cambria*, commanded by Mr. L. A. Egglesfield, left Southampton to carry out a survey of certain parts of the African route, which will be flown over regularly by flying-boat after June 1. The alighting points on the Nile will be tested and the boat will probably be taken as far as Kisumu, Victoria Nyanza. Subsequently, trials will be made along the coastal route between Mombasa and Durban.

Incidentally, at the Imperial Conference, which opens on May 14 in London, Empire air connections will be considered, as well as the question of Pacific and Atlantic air bases and services.

South American Extensions

SCADTA, the Colombian air transport concern, has extended its services to include the city of Hondo, and is planning to extend its Bogota-Cali service to Quito in the very near future. Meanwhile, the Venezuelan mail operations have been pushed on into the interior of the country—almost to the Colombian border—and there is a good chance that a link between the two countries will be arranged in due course.

For some years the Aeroposta Argentina Co. has been operating weekly round trips between Bahia Blanca and Tierra del Fuego, and between Bahia Blanca and Comodoro Rivadavia. A new decree suggests that there will in future be a connection with Buenos Aires. Some time ago a strong Argentine syndicate purchased the operating company concerned.

More D.H. Machines for Turkey

IN order to augment their small initial fleet of three D.H. Rapides, the Turkish State Air Lines have now ordered four D.H.86Bs, one D.H. 89A, one Dragonfly, and one Tiger Moth. This useful contract has been placed following a visit to Turkey by Mr. C. S. Thom, the D.H. sales manager.

The service between the commercial centre at Stambul and the seat of government at Ankara has been successfully operated during both summer and winter, when the aerodromes were snow-covered, and the daily service is now carrying an increasing fare-paying traffic. Further air routes are to be exploited.

The Dragonfly is intended for charter and training work, while the Tiger is to be equipped for blind-flying training and will be used for the other branches of instruction.

Canadian "Convertible"

"SEKANI" is the Canadian-Indian word for "mountain dweller," and has been applied to a new twin-engined monoplane developed by Fairchilds for Canadian service. Wheels, skis or floats may be specified, and the standard power plants will be Wasp Juniors of about 400 h.p. apiece, although the new Fairchild Ranger inverted air-cooled vees (on the lines of our Gipsy Twelve) can be mounted if desired.

The wings of the Sekani have solid spruce spars and the fuselage is of welded-steel tubes. Stub wings (the machine is a high-wing type) permit partial retraction of the land undercarriage and house fuel tanks.

At full power 192 m.p.h. should be attained at 5,000ft. as a landplane, floats deducting about 11 m.p.h.

In its normal landplane guise the Sekani weighs 5,000 lb. empty and 8,500 lb. fully loaded.

NEXT WEEK'S ISSUE

AT the time of the last Coronation of a British monarch—in the year 1911—the country's aviation manufacturing resources lay with a nucleus of mainly small concerns grappling bravely with the problems of what was then an almost unknown science.

Twenty-six years later another Coronation—that of His Majesty King George VI—sees this nucleus grown to a powerful and highly organised industry, annually producing thousands of speedy, safe and efficient civil and military aircraft for use at home and abroad.

The story of this development is a romantic one indeed, and in next week's issue of *Flight* special articles will deal with the milestones of progress during these twenty-six prolific years.

NEXT THURSDAY FLIGHT MAY 6

AIR MAIL COMMENTARY

By ALEX DAVIS

SHOULD air-mail stamps be different in shape from other stamps? This old queston is raised anew by recent diamond-shaped issues from Costa Rica and from Tannou-Touva.

In favour of this and similar shapes it is argued that air-mail letters should be made as readily distinguishable from other letters as possible, so that the postal sorting clerks can pick them out for quick despatch; against, it is argued that they become freak issues selling to philatelists, and their real purpose is obscured.

Certainly one must suspect a desire to sell to philatelists behind the Tannou-Touva issue, for here in one set are included also triangular and rectangular stamps.

Of the Costa Rica issue, illustrated on this page, the most notable thing apart from its shape is the illustration of a Ryan Brougham, because just the same picture (but with different scenery beneath the machine) has been used previously, both in Costa Rica itself and in Ecuador, on earlier air stamps.

A Junkers Ju. 52 is illustrated—for the first time on a postage stamp, I believe—on the latest 1½d. issue of South-West Africa. Intended for general postal use, it shows also a modern steamship and locomotive.

The new diamond-shaped Costa Rica issue. The aeroplane is the Ryan Brougham of *circa* 1930.

Spain provides something new in air stamps with an issue for Franco's aviation fund—overprinted with the words "Pro Avion" and "Zaragoza." Other new overprinted issues are from Panama and Guatemala, while an original design comes from Portugal, with a symbolical composition of airscrew and shield; only 10,000 sets were issued, and some values are hard to get. The designer is Almada, and his work is refreshingly modern. Danzig, on the other hand, is comparatively traditional in a new set of two stamps, with a skyline of city over which flies a combination of aeroplane and swastika.

On the first through flight from Liberia to Europe very little mail was carried, and a cover (reproduced here) flown right through to England is already priced at £5. There is a special cachet applied, with wording in English: "West Coast of Africa—France; Aeromaritime; Air France; 1st Voyage; March, 1937." An aeroplane is also illustrated in outline.

This cover, carried from Liberia by the new Aeromaritime service, was flown right through to England. It is also generously stamped and postmarked on the reverse side.

Another inconspicuous but interesting mark on air-mail covers includes the words: "1 let Praha-Bruxelles" (first flight from Prague to Brussels) and the date April 5. It comes from Czechoslovakia and bears air stamps of that country.

Yet another new cover carries the stamps of Palestine and reception postmark of Bucharest. It was carried on the first flight of the Polish Lot company's Palestine-Warsaw service, recorded in *Flight* on April 5.

Collectors of souvenirs such as these have recently welcomed two new publications—the reissued *Aero Field*, published by Mr. Francis J. Field and edited by Mr. N. C. Baldwin; and the new edition of *Gibbons' Air Stamp Catalogue*, which appears for the first time in a stiff cover. This, the fifth edition, lists 304 more air stamps than the fourth. If the present tendency to carry air mail at no extra fee continues to spread, there should be a slowing down of the torrent of such stamps—*should* be if Governments would cease to issue stamps to make profit from collectors.

Piston Service

MR. J. VERNON KELLY, until recently in charge of the Hepworth and Grandage piston and ring depot at Birmingham, has moved to London to take over the firm's imposing new depot at 78, York Road, King's Cross. Mr. T. Wilson succeeds him at Birmingham.

Repetition Work

IT may be recalled that a few months ago *Flight* mentioned the large supplies of aircraft small parts held in stock by A.G.S., Ltd., at their Hanworth premises.

The firm now states that, in order to cope with the heavy demand for nuts, bolts, etc., they have installed a battery of automatics, which are working on a 24-hour schedule. Nevertheless, they are able to undertake repetition work of all classes for Air Ministry contracts.

The Coronation and the Car Industry

HIS MAJESTY KING GEORGE VI was born in the year 1895 and, by a coincidence, it may be said that the life of the automobile industry dates from that year—a year which also saw the founding of our sister journal *The Autocar*.

It is thus particularly fitting that *The Autocar*, in its Special Coronation Number (on sale to-morrow, Friday), should have for its main themes the development of the British car industry during this forty-two years and our reigning monarch's interest in many aspects of motoring.

These themes have been developed on most interesting lines, but what is even more outstanding is their presentation from the illustrative point of view. That usually overworked adjective "magnificent" can be applied truthfully and without exaggeration to the make-up of this great issue, which is printed in four-colour, two-colour and photogravure.

Outstanding among the special features are portraits of Their Majesties the King and Queen, in full colour, by Algernon Rowe; "This Heritage," an article which includes some most attractive coloured scenic illustrations by R. E. Poulton; "The King and his Pastimes"—a pictorial feature; biographies of the leading car firms in the industry, in which those who have owned cars at any time during the past 42 years will recognise many old friends; a review of coachwork development during the same period; a Coronation guide, giving details of traffic regulations; "Some London Cameos"; "The King's Garage and Mews"; and eight pages of photogravure illustrations, including pictures of recent automobile sporting events

This notable Special Number will be on sale on Friday, April 30, price 6d.

NEW COMPANIES

In the notes below, for reasons of space, the "objects" of new companies are usually somewhat abbreviated.

BRITISH-AMERICAN AIR SERVICES, LTD., was registered as a private company on April 23, with a nominal capital of £100 in 100 shares of £. The objects are to establish, develop and work air services in any parts of the world. The first directors are to be appointed by the subscribers. Solicitors: Glover, Scott and Anthorpe Webb, 115, Park St., London, W.1.

AEROPARTS ENGINEERING COMPANY LTD.—Private company, registered April 23. Capital, £3,000 in 3,000 shares of £1. Objects: to carry on the business of aircraft constructers and builders and type-testers of engines and aeroplanes, etc. The directors are: Hugh K. Pierson, Cyril H. Shelton, Robert White. Solicitor: Frank T. Carver, 44, Bridge Street, Hereford.

JABLO PROPELLERS LTD.—Private company, registered April 22. Capital, £10,000 in £1 shares (6,000 "A" ordinary and 4,000 "B" ordinary). Objects: to carry on the business of manufacturers of and dealers in airscrews, aeronautical engineers, dealers in aircraft and all components therefor, etc. The first directors are Hamilton Fulton, O.B.E., Harry Delacombe, O.B.E., Walter R. Chown and Arthur G. Murrell. Registered office: Brettenham House, Lancaster Place, W.C.2.